A TAXONOMIC REASSESSMENT OF THE SUBTRIBE ASCLEPIADINAE (ASCLEPIADACEAE) IN SOUTHERN AFRICA

by
Ashley Nicholas
B.Sc. (UNP); B.Sc. Hons. (UNP); M.Sc. (UNP)

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Promoter: Prof.Dr. H. Baijnath
Co-Promoter: Prof.Dr. C.B. Rogers

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Statue of *Flora*, the Roman goddess of plants, in the Louvre in Paris

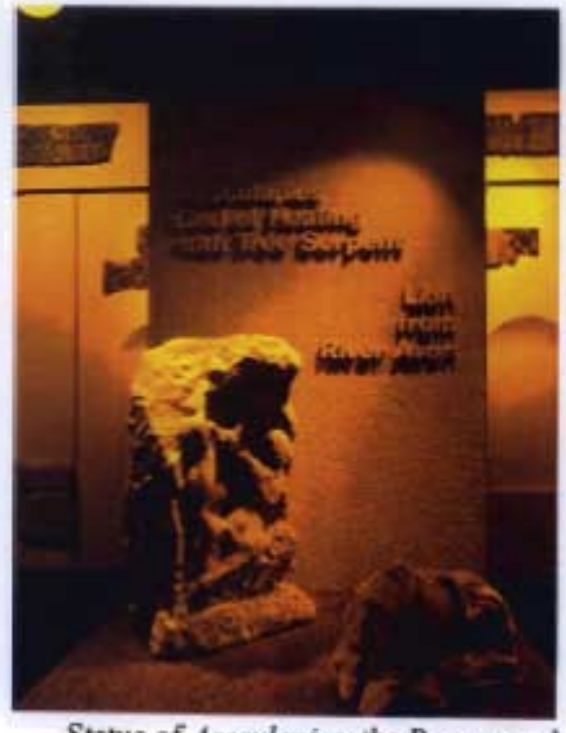
Linnaeus on the flora of South Africa

"May you be fully aware of your own fortunate lot, not only in being permitted by the Supreme Disposer of events to inhabit, but also to enjoy the sovereign control of, that paradise upon earth, the Cape of Good Hope, which the Beneficent Creator has enriched with his choicest wonders. Certainly, if I were at liberty to change my fortune for that of Alexander the Great, or Solomon, Croesus, or Tulbagh, I should without hesitation prefer the latter."

in letter to Governor Ryk Tulbagh

Dedicated to my Parents
Dorothy Cecilia Nicholas & George Nicholas.
I would not have come this far had
it not been for their sacrifice, confidence
and support at all times.

"Ad astra contendite"



Statue of *Aesculapius*, the Roman god of medicine commemorated in the generic name *Asclepias*, in the British Museum London

SUMMARY

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ASHLEY NICHOLAS

Promoter: Prof.Dr. H. Baijnath
Co-Promoter: Prof.Dr. C.B. Rogers

DEPARTMENT OF BOTANY, FACULTY OF SCIENCE
UNIVERSITY OF DURBAN-WESTVILLE

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PHILOSOPHIAE DOCTOR

This study extends an earlier M.Sc. research project on the narrow-leaved species of the genus *Asclepias* L. (30 species) to cover the entire subtribe Asclepiadinae *sensu* K. Schum. in southern Africa* (182 species in 23 genera). Two genera (*Eustegia* R. Br. and *Pentarrhinum* E. Mey.) are revised and then removed from this tribe. The remaining 177 species and 21 genera form the focus of this thesis, whose principal objectives are to re-evaluate the taxonomic and evolutionary significance of various macro, micro and chemical characters and then use them to produce a classification that, more closely, reflects the overall similarity and phylogeny of the taxa involved. Species and genera are recircumscribed based on the wealth of data that has come to light since the subtribe was last revised by N.E. Brown (1907—1908) some 90 years ago. This process was supplemented by extensive field work, observations on pollination and reproductive biology, ecology, biogeography, conservation and ethnobotany.

The majority of this thesis consists of a compilation of 17 papers, 12 of these published and most, but not all, of the remainder in preparation for press. Two of these papers form the bulk of the taxonomy. The first deals with what was the genus *Asclepias* in southern Africa. The genus is now believed to be confined to the Americas. The

* Botswana, Lesotho, Namibia, South Africa and Swaziland.

southern African species have diverse origins and are partitioned into 7 genera, one of them (*Gomphocarpus* R. Br.) resurrected, two of them (*Aidomene* Stopp and *Aspidonepsis* Nicholas & Goyder) expanded and four of them (*Paulforstera*, *Sigridia*, *Bruynsia* and *Pachyacris*) described as new. *Gomphocarpus* is divided into two subgenera and *Aidomene* into four subgenera. Three new species are also described.

The second paper investigates the bulk of most of the remaining genera. *Kanahia* R. Br., *Cordylogyne* E. Mey. and *Fanninia* Harv. remain as is. *Xysmalobium* R. Br., previously a genus of 19 species in southern Africa, is reduced to three species in two subgenera. *Trichocodon* is segregated off from *Pachycarpus* E. Mey. as a new genus. While two species, previously placed in *Xysmalobium*, are added to *Pachycarpus*, but placed in the new subgenus *Parapodiopsis*. *Parapodium* E. Mey. is reduced from three to two species and *Periglossum* Decne. is reduced from five to three species, one of them newly described. *Woodia* Schltr. and *Stenostelma* Schltr. are both considerably expanded, mainly with species previously housed in *Xysmalobium*), and the former divided into two subgenera.

The third paper briefly looks at the *Schizoglossum* E. Mey., *Miraglossum* Kupicha and *Aspidoglossum* E. Mey. Some changes are suggested but, as further work is needed, none are formalised.

As a corollary to the taxonomy, secondary metabolite profiles of 38 species and 17 genera were done using Thin layer Chromatography. The results sometimes confirmed morphological patterns and sometimes were at odds with them. A trend from simple profiles to more complex profiles seems to echo the suspected phylogeny of the genera within this subtribe. Some species and genera have greater chemical diversity than others and secondary metabolites are shown to vary considerably in different parts of a single plant.

As a supplement to the above work or because they are cited elsewhere in the dissertation, published papers dealing with floral structure, the asclepiadaceous work of Rudolf Schlechter, as well as miscellaneous works in the tribe Stapelieae, are also given.

KEY TERMS: Taxonomy, southern Africa, Asclepiadinae, Asclepiadaceae, Apocynaceae, Chemotaxonomy

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CHAPTER 1

INTRODUCTION

It is my hope that this study will contribute positively to the knowledge base of the subfamily Asclepiadoideae in southern Africa. This contribution is made in the full realization that science is incremental rather than cosmic and that it is a cooperative process (Rangachari, 1994). We have come this far because of the work that has already been done. The horizon of modern science is only possible because we stand on the shoulders of those who have gone before — A. Nicholas

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

1.1.1 History & Taxonomy Considerations

The genera that constitute the subtribe Asclepiadinae Endl. ex Meisn. in southern Africa were last revised as an entity by N.E. Brown in 1907—1908 for the **Flora Capensis**. Almost a hundred years have passed since this pivotal and still widely used work was produced. The number of specimens that have been collected since then have increased from hundreds to thousands. This increase in specimens has not only meant that species limits have changed, sometimes quite substantially, but that a number of new species have come to light. However, just as important as the need to recircumscribe species limits is the need to produce an explicit phylogenetic classification. Although N.E. Brown placed similar taxa near each other to produce a somewhat natural system, it was never intentionally phylogenetic. This is understandable given that evolutionary theory was, during N.E. Brown's time, not well understood or universally applied to classifications. In particular, the extent to which convergent evolution (mainly in response to pollinator pressure) produced a large number of homoplasious floral characters was not appreciated at this time (Nicholas, 1989). As a result, a number of genera, some of them quite large, were constructed base on solitary convergent characters, such as the possession of a corona-lobe sinus (*Asclepias sensu* Schlechter 1896, 1897 & 1898 and; N.E. Brown 1908) or simple blob-like corona-lobes (*Xysmalobium sensu* Scott-Elliot 1909 & N.E. Brown 1907). Only recently have workers tried to resolve this problem by attempting to produce congruous monophyletic groups. Kupicha (1984) for *Schizoglossum* E. Mey. and allies, Langley (1980) for *Xysmalobium* and Nicholas (1990 & 1992) for *Asclepias*. Nearly all of these genera were found by these workers to be polyphyletic. The main objective of this thesis is to apply this process, of finding phylogenetic congruent groups, to the entire subtribe in southern Africa. A workable phylogenetic classification for the 182 species and 23 genera of the Asclepiadinae will be a valuable contribution to the

taxonomy and conservation of this group of plants in southern Africa. Such a phylogenetic system will not only be more predictive, but also heuristic. A similar process was started for the tropical and west African genera by Bullock (1952 to 1963) and is being continued by Goyder (1998a & 1998b).

Although the major genera of the subtribe have recently been investigated, namely *Pachycarpus* E. Mey. (Smith 1981 & 1988), *Xysmalobium* R. Br. (Langley 1980), *Asclepias pro parte* (Nicholas 1981), and *Schizoglossum*, *Aspidoglossum* and *Miraglossum* (Kupicha, 1984), the many minor genera have not been revised viz. *Parapodium* E. Mey., *Cordylogyne* E. Mey, *Fanninia* Harv., *Woodia* Schltr. *Eustegia* R. Br. and *Pentarrhinum* E. Mey. Exceptions to this are *Periglossum* Decne., *Stenostelma* Schltr., (Bullock, 1956) and *Kanahia* R. Br. (Bullock 1952 &1954a and; Field *et al.*, 1986). In this study we have not only investigated these smaller genera, but also re-examined concepts in *Pachycarpus*, *Xysmalobium*, *Asclepias* and *Schizoglossum* and allies. This more inclusive approach, plus an insight into the taxonomy of the tropical African genera of this subtribe, has lead to genera quite different from those proposed before. These newly proposed or recircumscribed genera are either monophyletic or paraphyletic (the holophyletic taxa of cladists), but not polyphyletic.

1.1.2 Synopsis of Taxonomy

The taxonomy in this paper is based on the examination of over 5000 herbarium specimens housed in herbaria in Africa, Europe and USA. Extensive field work was undertaken in southern Africa. American species of *Asclepias* in cultivation at Kew as well as wild population in the United States were also investigated. The results of this investigation, which covers 182 species in 21 genera are briefly outlined below:

Table 1. Comparison of the Generic Classification of the subtribe Asclepiadinae by N.E. Brown 1907—1908 and that given in this dissertation.

N.E. Brown 1907—1908	Nicholas *et al.*
—	*Kanahia* (1 sp)
Asclepias (51 sp.)	—
—	*Gomphocarpus* (10 sp.)
—	*Paulforstera* (6 sp.)
—	*Sigridia* (5 sp.)
—	*Bruynsia* (9 sp.)
—	*Aidomene* (10 sp.)
—	*Pachyacris* (28 sp.)
—	*Aspidonepsis* (6 sp.)
Xysmalobium (19 sp.)	*Xysmalobium* (3 sp)
Pachycarpus (26 sp.)	*Pachycarpus* (21 sp.)
Parapodium (3 sp.)	*Parapodium* (2 sp.)
Woodia (3 sp.)	*Woodia* (9 sp.)
Stenostelma as *Krebsia* (2 sp.)	*Stenostelma* (8 sp.)
Periglossum (4 sp.)	*Periglossum* (3 sp)
Cordylogyne (1 sp.)	*Cordylogyne* (1 sp.)
Fanninia (1 sp.)	*Fanninia* (1 sp)
—	*Trichocodon* (5 sp.)
—	*Stathmostelma* (1 sp.)
Schizoglossum (89 sp.)	*Schizoglossum* (12 sp.)
—	*Miraglossum* (7 sp.)
—	*Aspidoglossum* (34 sp.)
Total: Genera 10 & species 199	Total: Genera 21 & species 182

Compared with the classification of N.E. Brown (1907-1908) the one presented here has reduced the number of species from 199 to 182, but increased the number of genera from 10 to 21.

Two genera studied, which are traditionally placed in the Asclepiadinae, were found not to fit here. These are *Pentarrhinum* E. Mey., which is a climbing herbaceous plant closely allied to *Cynanchum* L., and *Eustegia* R. Br., which appears to have three separate corona-lobe whorls of almost equal status. Both have, as a result, been moved to the subtribe Cynanchinae. A new subspecies, *angolense* (N.E. Br.) Liede & Nicholas, is described under *Pentarrhinum abyssinicum* Decne. *Eustegia*, a South African endemic, is

reduced from five to three species. Investigation of *Asclepias* species from South, Central and North America, as well as from all over Africa, suggest that the American species of this genus probably had a different origin from the southern African species. These American species sit nearer the tropical African genus *Margaretta* Oliv., with which they may have had a common origin. The southern African species are of diverse origin, but none sit near the American *Asclepias* species. Because of the possession of a corona-lobe sinus, all these species had been placed in the genus *Asclepias*, however, this character is homoplasious and has evolved separately in a number of unrelated genera. Southern African species, previously placed in *Asclepias*, are partitioned between seven separate genera: *Gomphocarpus* R.Br., *Paulforstera* Nicholas, *Sigridia* Nicholas, *Bruynsia* Nicholas, *Aidomene* Stopp, *Pachyacris* Schltr. ex Nicholas & Goyder and *Aspidonepsis* Nicholas & Goyder. The older name *Gomphocarpus* is resurrected and divided into two subgenera. One of these, *Leiocalymma* Goyder & Nicholas, is newly described. There are 10 southern African species of *Gomphocarpus*, one of these, *G. otiocephalus*, is newly described. *Aidomene*, previously a monotypic Angolan genus, is expanded from one to 10 species, one of which, *A. hespera* Nicholas & Goyder, is newly described. This large and diverse genus is divided into four subgenera. *Aidomene* is closely allied to *Trachycalymma* K. Schum. which was previously thought to occur in southern Africa, but actually occurs only in tropical Africa. *Aidomene* subgenus *Callocymbion* Nicholas & Goyder is related to *Fanninia* Harv., *Trichocodon* Nicholas and some species within *Schizoglossum* E. Mey. *Pachyacris*, a name proposed by Schlechter (1894), but never validly published, is adopted for a large complex of 28 species. The majority of these species are transferred from what was *Asclepias*; however, a number are also moved from the genus *Xysmalobium* R. Br. *Aspidonepsis*, a genus more closely related to *Aspidoglossum* E. Mey., was described in 1992, but is expanded in this thesis to include *A. delagoense* (Schltr.) Nicholas & Goyder. *Sigridia*, *Paulforstera* and *Bruynsia* are newly described. *Paulforstera*, a genus of 6 species, allied to *Gomphocarpus*, is divided into two subgenera. *Sigridia*, a genus of 5 species, contains some rare taxa and is of unknown affinity; although it may have links with *Gomphocarpus* subgenus *Leiocalymma* via *S. viridiflora*. *S. concinna* is also somewhat reminiscent of species in

Paulforstera. *Bruynsia*, which is divided into two sections, is a genus of 9 species. It shares a common origin with *Stenostelma* and allies.

Kanahia R. Br. has one species in South Africa while *Cordylogyne* E. Mey., and *Fanninia* are monospecific. *Kanahia* is shown to be the probable ancestral sister group of the genus *Gomphocarpus*. *Xysmalobium sensu* N.E. Brown (1907 & 1902) is paraphyletic (a conclusion with which Langley 1980 agrees). In southern Africa, this ethnobotanically important genus, is reduced from 19 species to three. Two are transferred to *Pachycarpus* E. Mey., but placed in the new subgenus *Parapodiopsis* Bullock ex Nicholas. Six species are transferred to the genus *Woodia* Schltr. Two are transferred to *Stenostelma* Schltr. The remainder are placed in *Pachyacris*. The three species remaining in *Xysmalobium* are divided into two subgenera: One species, *X. woodii*, is similar to the genus *Calotropis* and is placed in the new subgenus *Bycanostele* Stewart & Langley ex Nicholas (table 2).

Table 2. Comparison of the proposed taxonomy of *Xysmalobium*, in southern Africa, over the last century

Xysmalobium		
N.E. Brown (1907)	**R. Langley** (1980)	**A. Nicholas** (1999)
Xysmalobium (18 sp.)	*Xysmalobium* (2 sp.)	*Xysmalobium* Subgenus *Xysmalobium* (2 sp.)
	Bycanostele (1 sp.)	*Xysmalobium* Subgenus *Bycanostele* (1 sp.)
	Parapodiopsis (2 sp.)	*Pachycarpus* Subgenus *Parapodiopsis* (2 sp.)
	Pseudowoodia (4 sp.)	*Woodia* Subgenus *Pseudowoodia* (9 sp.)
	Saxymolbium (1 sp.)	*Stenostelma* (10 sp.)
	Pachyacris (8 sp.)	*Pachyacris* (28 sp.)
	New Genera = 5	New Genera = 1

Five species which are more closely related to *Fanninia* and *Aidomene* are removed from *Pachycarpus* and placed into the new genus *Trichocodon* (DMN Sm.) Nicholas. What remains of *Pachycarpus* is shown to have had a common ancestry with *Xysmalobium* and *Parapodium* E. Mey. (table 3)

Table 3. Comparison of the proposed taxonomy of *Pachycarpus*, in southern Africa, over the last century

Pachycarpus		
N.E. Brown (1908)	**D.M.N. Smith** (1988)	**A. Nicholas** (1999)
Pachycarpus (26 sp.)	*Pachycarpus* (24 sp.)	*Pachycarpus* subgenus *Pachycarpus* (21 sp.) *Pachycarpus* subgenus *Parapodiopsis* (2 sp.)
		Trichocodon (5 sp.)
	New Genera = 0	New Genera = 1

Parapodium is reduced from three to two species. *Woodia* is expanded from three to 10 species, and divided into two subgenera, one, subgenus *Pseudowoodia* Bullock ex Nicholas, is newly described and houses the bulk of *Woodia* species. *Stenostelma* is expanded from three to eight species. *Periglossum* Decne. is reduced from five to three species, with the addition of the newly described *P. podoptyches*. Only one species of the large primarily tropical African genus *Stathmostelma* K. Schum. occurs in southern Africa.

Like *Xysmalobium* and *Asclepias sensu* N.E. Brown, we believe *Schizoglossum sensu* Kupicha to be paraphyletic and also that species concepts are too broad to be of practical use, especially in conservation and biogeography. Some sections of *Aspidoglossum* may also need to be raised to generic status. *Miraglossum* Kupicha is well defined as is.

Goyder, in revising many of the tropical African genera of the Asclepiadinae, has also found it necessary to, not only redefine many of N.E. Brown's taxa, but also many of Bullock's. So far he has revised the following genera in this subtribe: *Stathmostelma* K. Schum. (Goyder, 1998a) and *Pachycarpus* (Goyder, 1998b), with *Gomphocarpus* and *Trachycalymma* in preparation (Goyder pers. com.).

1.1.3 Infrafamilial Classification

The infrafamilial classification of both an expanded Apocynaceae (Thorne 1976) or Asclepiadaceae *sensu lato* has been a contentious and emotive topic. Almost as many opinions exist on the infrafamilial classifications as there are workers in the family.

The family Asclepiadaceae was split off from the Apocynaceae by Robert Brown (1810), a system widely, but not universally followed. Recently, opinion has begun to swing towards reuniting the two families. This movement, initially championed by Thorne (1976), has gained extensive acceptance, especially in the USA and by workers on the African flora (Goyder, 1998; Liede, 1997 and Venter & Verhoeven, 1997). This has been mainly due to the results of cladistic and molecular studies that suggest the Asclepiadaceae *sensu lato* is monophyletic, but paraphyletic within the context of the Apocynaceae, that is derived from within the Apocynaceae (Civeyrel *et al.*, 1997 and Struwe *et al.*, 1994). Paraphyletic groups are considered untenable by strict cladists (Donoghue & Cantino, 1988, van Welzen, 1997). Nicholas & Baijnath (1994) instead of sinking the Asclepiadaceae into the Apocynaceae, opted to follow Rosattii (1989a & 1989b) who proposed a hierarchical solution to the problem. By placing the two families in the Suborder Apocynineae any problems concerning paraphylly are solved. Although the use of the suborder Apocynineae solves paraphyletic problems it does not solve problems surrounding the taxonomy of the Asclepiadaceae *sensu lato*. Good reasons exist for separating the Periplocoideae from the family (Bullock, 1956; Dyer, 1975, Hutchinson, 1969 and; Schlechter, 1905 & 1924.) However, if this is done then the same reasoning should be applied to the Secamonoideae which would also deserve family status. The classification of the Apocynineae would end up with four families: Apocynaceae, Periplocaceae, Secamonaceae and Asclepiadaceae. However, if all are treated at family level without being included in the suborder Apocynineae then they loose any indication of their very close affinities when viewed in the context of the entire Gentianales. The more sensible solution is to reduce all these taxa to subfamilial rank under an expanded Apocynaceae. This solution does away with the need to employ subordinal rank, solves any problem of paraphylly and all taxa remain clearly related when viewed in the context of the Gentianales. This is the classification followed here in this thesis. A third alternative exists and that is to accept the family Asclepiadaceae as

paraphyletic. I believe such a system is acceptable providing workers are aware of the paraphylly. Paraphyletic groups only become problematic when they are seen and treated as if monophyletic. Monophylly is an essential part of the philosophy of strict cladism. Only taxa originating from a common ancestor may be grouped together (viz. monophyletic) and are considered "true groups". Unfortunately, there are many difficulties with applying this philosophy to classifications (Brummitt, 1997, Hedberg, 1995 and Sosef, 1997) and many workers have opted to continue using paraphyletic groups (Cronquist 1988). Some cladists have also begun to accept paraphyletic groups, but prefer to use the cladistic term holophyletic for these.

R. Brown (1810) when he proposed the family Asclepiadaceae divided it into three groups based on the pollinarium structure: Group I. Asclepiadeae *Verae* or true asclepiads (with two pollinia per pollinarium), Group II unnamed but containing *Secamone* (with four pollinia per pollinarium) and, Group III Periploceae (with granular pollen). These groups still hold true and form the basis of the subfamilies Periplocoideae, Secamonoideae and Asclepiadoideae. Since Brown's inception of the family, five workers (all in the 1800s) have undertaken world wide revisions of the Asclepiadaceae at the generic level: Don (1838), Endlicher (1838), Decaisne (1844), Bentham & Hooker (1876) and Schumann (1895). No world wide revision of the family down to specific level has appeared this century.

Following R. Brown, Don (1837) was the next to attempt a universal infrafamilial classification for this family. He divided it into five tribes (Orthophuramiae, Gonolobeae, Asclepieae, Secamoneae and Periploceae). Tribe Orthophuramiae was, in turn, divided into two subtribes (Stapelieae and Hoyaceae). See appendix.

Decaisne (1844) divided the Asclepiadaceae into 5 tribes (Periploceae, Secamoneae, Asclepiadeae *Verae*, Gonolobeae and Stapeliae). He was the first to place the Periplocoideae at the beginning of his series followed by Secamonoideae; finally reflecting the increasing evolutionary complexity of the pollinarium. The Asclepiadeae *Verae* was subdivided by him into nine subtribes (Astephanae, Microlomae, Haplostemmae, Cynoctonae, Sarcostemmae, Eustegiae, Asclepiadae, Ditassae and Oxypetalae). Interestingly, the Eustegiae contains the genera *Fockea*, *Eustegia* and also *Cynanchum* (see our comments in chapter 6.4.2 where we revise the genus *Eustegia*). The

Asclepiadinae, as defined for southern Africa in this thesis is encompassed by three of Decaisne's subtribes: Haplostemma (containing *Parapodium*, *Cordylogyne*, *Xysmalobium*, *Periglossum*), Sarcostemmae (containing *Calotropis* and *Kanahia*) and Asclepiadae (containing *Schizoglossum*, *Aspidoglossum*, *Lagarinthus*, *Gomphocarpus* and *Asclepias*. *Pentarrhinum* is also placed here by him). The tribe Stapeliae he subdivided into 3 subtribes (Pergulariae, Gymnemae and Ceropegiae). See appendix. Decaisne's system was widely used by other workers.

Bentham & Hooker (1868) divided the family into two subfamilies (Periploceae and Euasclepiadeae). The Euasclepiadeae was subdivided into six tribes (Secamoneae, Cynancheae, Gonolobeae, Marsdenieae, Ceropegieae and Stapelieae). Their system was widely used by British botanists, including those who prepared the colonial floras of Africa, India and Australia. It is this system that was largely used by N.E. Brown when he prepared the **Flora of Tropical Africa** (1902) and **Flora Capensis** (1907).

Schumann's system (1895) is the one that has been most widely followed. He divided the Asclepiadaceae into two subfamilies (Periplocoideae and Cynanchoideae). The Cynanchoideae (equivalent to the Asclepiadoideae) he subdivided into four tribes (Asclepiadeae, Secamoneae, Tylophoreae and Gonolobeae). The Asclepiadeae he subdivided into 5 subtribes (Astephaninae, Glossonematinae, Asclepiadinae, Cynanchinae and Oxypetalinae). Because his study was based on extensive data, much of it collected by careful dissection, it is his circumscription of the subtribe Asclepiadinae that has essentially been used in this study. The Tylophoreae he subdivided into 2 subtribes (Ceropegiinae and Marsdeniiae). See appendix.. It is Schumann's system that was used by Dalla Tôrre & Harms (1900—1907), Bramwell (1978), Thonner 1915, Rendle, 1925, Willis (1951) and Woodson (1941). Quite rightly, there is a lot of disagreement concerning the circumscription of Schumann's subtribes. There are so many lines of evolution within the tribe Asclepiadeae, most of which are not adequately catered for in his system. Also many subtribes are defined using homoplasious characters, such as coronal synorganization that they are often not phylogenetically decorous. Unlike any other system produced before or since, Schumann based his subdivision on a great number of diagnostic features and no one has yet produced a system that equals it at this level. Even though it does not adequately echo evolution within the tribe, we have opted

to follow his classification here and if possible to refine it within the context of southern Africa.

Bullock (1956) followed Schlechter (1905 & 1924) in raising the Periplocoideae to family status. He then subdivided the Asclepiadaceae *sensu stricto* into two subfamilies (Secamonoideae and Asclepiadoideae). The Asclepiadoideae was in turn divided into four tribes (Asclepiadeae, Marsdenieae, Gonolobeae and Ceropegieae). The last of these, the Ceropegieae, containing the stapeliads as well.

The system proposed by Bruyns & Forster (1991) largely follows that of Bullock (1956), although they make no reference to this fact. Their paper concentrates mainly on the sinking of the Ceropegieae under the older name Stapelieae (equivalent to Bullock's Ceropegieae). Ideas concerning the amalgamation of these two taxa dates back to Bullock (1956) and not to Bruyns (1987) as claimed in this paper. Bruyns and Forster divide the Asclepiadaceae *sensu lato* into three subfamilies (Periplocoideae, Secamonoideae and Asclepiadoideae). The Asclepiadoideae is then subdivided into four tribes (Gonolobeae, Asclepiadeae, Marsdenieae and Stapelieae).

Liede & Albers (1994) subdivide the Asclepiadaceae into three subfamilies (Periplocoideae, Secamonoideae and Asclepiadoideae). The Asclepiadoideae is, in turn, divided into five tribes (Asclepiadeae, Fockeeae, Gonolobeae, Marsdenieae and Stapelieae). However, this is a nomenclatural treatment (consisting of a list of genera) and no reasons for the division are given. There are also no keys to the taxa involved. In this sense their work is similar to that of Sundell (1980) which was also nomenclatural. Later, Liede (1997) sunk the Gonolobeae into the Asclepiadeae as a subtribe.

Ollerton & Liede in an appendix to a 1997 paper, propose a system of classification based on Bruyns & Forster (1991), Liede & Albers (1994) and Liede (1997). Here they divide the family into three subfamilies (Periplocoideae, Secamonoideae and Asclepiadoideae). The Asclepiadoideae is, in turn divided into four tribes (Fockeeae, Marsdenieae, Stapelieae and Asclepiadeae). The Asclepiadeae is then divided into six subtribes (Asclepiadinae, Astephaninae, Glossonematinae, Gonolobinae, Metastelatinae and Oxypetalinae). These authors demonstrate that pollination syndromes can be loosely correlated with their classificatory system. This suggests that pollination has been the main force driving diversification in the family not only at the specific level,

but also the macrotaxonomic level. The system proposed by Swarupanandan *et al.*, (1996) apparently differs from other more recent schemes, but I have not yet had an opportunity to view their work.

For more extensive discussion on the infrafamilial classification of the Asclepiadaceae see also Nicholas (1982) and Smith (1980)

Many authors have also proposed infrafamilial classifications based on taxa within limited geographical areas: Bullock (1956) for Africa, Bullock (1963) for West Africa, Fournier (1882) for the Americas, Gray (1878) for the United States, Huber (1983) for Sri Lanka, Richard (1850) for northeast Africa; Rosatti (1989a & 1989b) for the southeastern United States and, Schlechter (1899) for the West Indies. A number have also been produced for southern Africa: Harvey (1868), Meyer (1838) and, Schlechter (1896, 1897 & 1898).

Other workers have concentrated on individual tribes or subtribes.

Periplocoideae: The infrastructural classification of this subfamily has recently been investigated by Venter & Verhoeven (1997). Characters of taxonomic and evolutionary importance are discussed in some depth and the subfamily is, for the first time, divided into tribes: Periploceae, Gymnanthereae and Cryptolepideae. A key to these tribes is provided and a list of genera belonging to each enumerated.

Secamonoideae: Civeyrel (1994), using pollinarium structure, shows that this subfamily may bridge the gap between the Periplocoideae and Asclepiadoideae. Klackenberg (1992) has, however, begun to question the monophylly of this subfamily.

Asclepiadoideae: Liede (1997) looked at the recircumscription of this subfamily.

Asclepiadoide: Fockeeae: The most recently proposed new tribe is the Fockeeae (Kunze *et al.*, 1994). This new tribe initially contained only two genera, *Cibirhiza* Bruyns and *Fockea* Endl., both removed from the Marsdenieae. Later Liede & Albers (1994) have added *Chymocorum* Harv. This tribe is based on a corona that is apparently three serried (but actually only two) and pollinaria that lack translator-arms and corpusculum. There is, in place of the corpusculum, a sticky pad, as is found in the Secamonoideae. Both these uncommon characters can, otherwise, be found elsewhere. We are not in a position to

evaluate the validity of this tribe, but the combination of characters suggest that it may be basal within the Asclepiadoideae.

Asclepiadoideae: Gonolobeae: Liede (1997) sunk the Gonolobeae as a subtribe under the tribe Asclepiadeae.

Asclepiadoideae: Asclepiadeae: Liede (1997) divides this tribe into 6 subtribes (Asclepiadinae, Astephaninae, Glossonematinae, Gonolobinae, Metastelmatinae and Oxypetalineae).

Asclepiadoideae: Asclepiadeae: Asclepiadinae: Despite the fact that this work does not include descriptions or keys it comes closest to the Asclepiadinae as envisioned here. All the genera dealt with in this thesis are included in her circumscription of the Asclepiadinae. However, *Periglossum* is treated as a synonym of *Cordylogyne*, a finding with which we do not concur.

Asclepiadoideae: Asclepiadeae: Astephaninae: Liede (1994), using a cladistic analysis, recircumscribed the subtribe *Astephaninae* (Decne.) Schumann to include genera previously housed in the subtribe Cynanchinae. In this paper she also discusses problems with infrafamilial classification of the family.

Asclepiadoideae: Stapelieae: Bruyns & Forster (1991) deal with the recircumscription of the tribe Stapelieae, giving, also, a list of genera that should be included. They reduce the tribe Ceropegieae to synonymy under this expanded Stapelieae. We concur with their findings although the occurrence of the pellucid margin on the pollinia is of much wider occurrence than outlined by them; also been found in the genus *Emplectanthus*. We believe the Stapelieae can be divided further into two subtribes, the Ceropeginae and Stapelinae. Victor & Nicholas (1998) have provided a key to the genera of the Ceropeginae in southern Africa. However, not everyone seems to agree with the sinking of the Ceropegieae under the Stapelieae (Leach, 1983 and Plowes, 1990), others have reversed their decision, initially treating the two as separate (Albers *et al.*, 1989, Meve & Albers, 1990) and later combining them (Liede & Albers, 1994).

Recent cladistic (Liede, 1996) and *rbc*L studies (Civeyrel *et al.*, 1998, Sennblad & Bremer, 1996) have been unable to confirm much of the classificatory systems proposed above. In fact, Civeyrel *et al.* (1998), has shown that while palynological data can be used to delimit subfamilies with in the Asclepiadaceae *sensu lato* it is not useful for delimiting

tribes of the subfamily Asclepiadoideae. They go on to show that *mat*K plastid sequences data suggests that these tribes have undergone parallelisms in several reproductive traits. Interestingly, these workers have also demonstrated that not only is the Asclepiadaceae *sensu lato*, monophyletic, but so are the Periplocoideae, Secamonoideae and Asclepiadoideae. The problem of paraphylly arises only because they are nested within the Apocynaceae.

Tribal and subtribal definitions as used in this thesis

The Asclepiadeae is defined using the following combination of correlated characters. Pollinia are one per locule and pendulous, pollinaria have well defined translator-arms and the presence of a corpusculum.

The subtribe Asclepiadinae is characterised by having small trees, shrubs or herbs (the majority of herbs being long lived geophytes with stem-tubers), leaves never thinly textured, flowers seldom with corolline corona, but always a staminal corona of free segments, the outer-corona is dominant while the inner-corona is small, vestigial or absent.

The Asclepiadinae differs from the closely related Cynanchinae in which plants are usually climbers or twiners (seldom herbs), with stems herbaceous or succulent, leaves coriaceous, thinly textured, or absent, flowers without a corolline corona, but always with a well defined staminal corona in which the outer- and inner-corona are of almost equal status, corona-lobes are usually fused or occasionally free, seldom is the inner-corona redundant. Southern African species that fall within the Cynanchinae are: *Pentarrhinum*, *Cynanchum* and *Sarcostemma sensu stricto*.

1.2. DISSERTATION OBJECTIVES

With *Pentarrhinum* and *Eustegia* removed from the subtribe, the remaining 182 species and 21 genera form the focus of this thesis.

The principal objectives are to:

1) Reevaluate the taxonomic and evolutionary significance of various macro, micro and chemical characters
2) Use these reevaluated characters to produce a classification that more nearly reflects the overall similarity and phylogeny of the taxa involved.
3) Recircumscribe species and genera based on the wealth of data that has come to light since the subtribe was last revised by N.E. Brown in 1907—1908.
4) Supplement the taxonomic process with extensive field work, observations on pollination and reproductive biology, ecology, biogeography and ethnobotany.
5) Reexamine and clarify the nomenclature of all taxa
6) Construct keys to all taxa.
7) To plot distribution maps for the species and infraspecific taxa of the subtribe Asclepiadinae within southern Africa
8) Provide conservation evaluations for all species and infraspecific taxa (Due to the massive degradation of many parts of southern Africa, conservation issue are now of paramount importance).

1.3 DISSERTATION LAY-OUT

This thesis consist mainly of a collection of separate papers (Schmid, 1986), connected by the fact that they all contribute towards the taxonomy of the subtribe Asclepiadinae in southern Africa or to the subfamily Asclepiadoideae. This is their common theme. Contributions are either in the form of published papers (produced here by photocopying reprints), or in manuscript format (papers intended for publication, but still in preparation or in press). However, some parts of certain chapters are not intended for publication.

Chapter consisting of already published papers may occasionally begin with a short introduction which discusses more recent aspects of the topic not covered in the body. The body of each chapter contains a more detailed introduction, plus its own materials and methods, results and/or taxonomy, discussion and references. Certain, philosophical aspects are discussed within each paper or chapter. This includes the philosophy behind group recognition and construction, tracing and then reflecting phylogeny in classifications and, concepts surrounding the allocation of conservation status (rare does not always mean threatened). Each paper included in this dissertation differs considerably in style, this is due, mainly, to the fact that different journals have different house styles and formats. These differences extend down to the way in which references are cited, synonomy given and even to spelling; papers published in American journals have followed American spelling. Most of the papers are collaborative. This approach was taken for three main reasons: 1) I have found that I learn and benefit most from such cooperative work; 2) The paper produced is of a much higher standard and benefits because of the broader knowledge involved, and; 3) Collaboration with workers in the rest of Africa is essential if a unified congruent taxonomy is to be achieved for the continent.

In taxonomic papers, genera, species and infraspecific taxa have, where possible, been placed in phylogenetic sequence from plesiomorphic to apomorphic However, this has not always been possible, especially in large genera in which several evolutionary lines can be discerned. Due to time and financial constraints, as well as technical considerations, species descriptions are not given here. However, these exist for most species and will be presented at a later date when this work is written up for the **Flora of Southern Africa.**

As far as possible we have followed author abbreviations given in Brummitt & Powell (1992) and herbarium abbreviations in Holmgren *et al.*, (1990). Nomenclature follows the Tokyo Code (Greuter *et al.*, 1994). Specimens are cited according to the new South African provinces, and distribution maps plotted using the GIS software program MAPPIT. Specimens were plotted according to their quarter degree grid. Only specimens seen by us, and for which we were sure of the identity, were used in constructing these distributions.

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CHAPTER 2

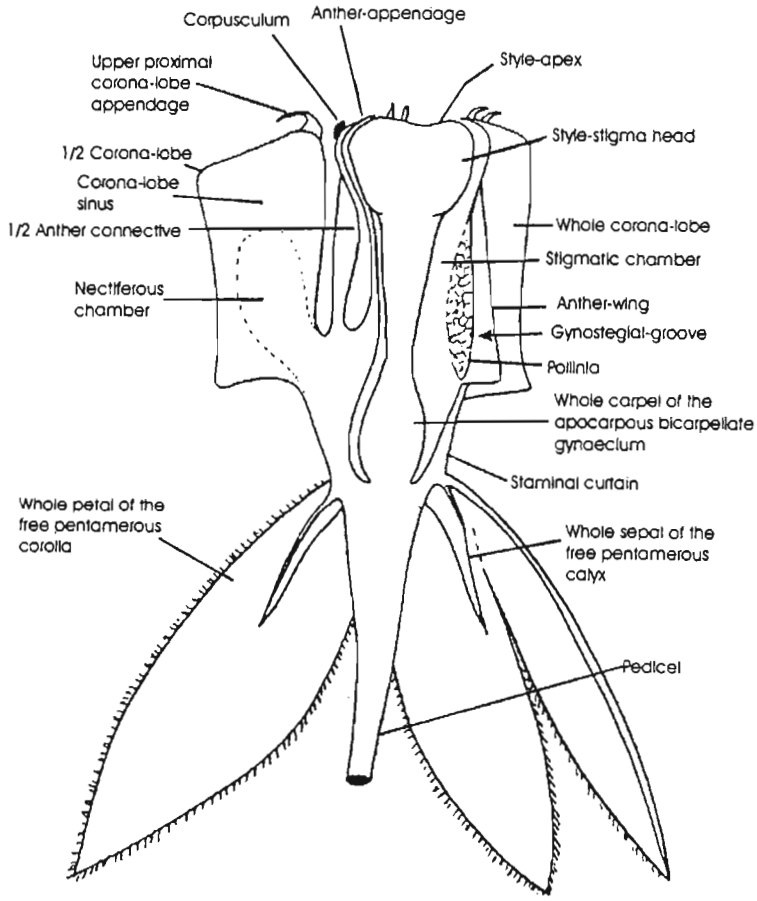
STRUCTURE OF THE ASCLEPIAD FLOWER

"Lindley found that 'from one cause or another, whether accident, ignorance, pedantry, over-fastidiousness, vanity or carelessness', the language of botany was 'marvellously in want of reformation'." Lindley's survey of descriptive botanical terminology still provides a basic glossary of botanical Latin." — W. Stearn 1966 in **Botanical Latin.**

CONTENTS

INTRODUCTION

This series of articles was produced for **PlantLife**, a journal for amateur botanists and plant enthusiasts. As a result, they are not written according to modern scientific convention. However, it was felt that they were an opportunity to introduce this readership to the complexities of asclepiad floral structure and, as a result, they are, at times, heavily technical. Our contributions to this unrefereed journal forms part of the University of Durban~Westville's community outreach programme and it's teaching, rather than scientific, bias is seen as a contribution to the South African government's RDP (Reconstruction and Development Programme). It has, in fact, been used by SABONET (Southern African Botanical Diversity Network) as an aid to an identification course, which formed part of one of their major training programmes (Janine Victor* pers. comm.). We are pleased that we have been able to give back to the parabotanical community in this small way.



Half-flower drawing of *Gomphocarpus physocarpus* x7

* National Herbarium, Pretoria

These articles although not specifically focused on the subtribe Asclepiadinae do contain much information on the floral structure in that subtribe. A thorough analysis and discussion of characters will be produced when a cladistic study is eventually published for the Asclepiadinae in southern Africa. However, this still needs to be done.

Full Citations For Papers Provided in this Chapter

NICHOLAS, A. & H. BAIJNATH. 1994. The structure of the Asclepiadaceae flower: Part i. **PlantLife.** 10: 18—20.

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The structure of the Asclepiadaceae flower

Ashley Nicholas & Snowy Baijnath, Department of Botany,
University of Durban-Westville, Private Bag X54001, Durban 4001

Introduction

When we started writing this article, we envisaged a short contribution on the interesting structure of the Asclepiadaceae flower. However, we soon realized that such a generalized article would not give readers an accurate picture of this organ in the family. The task needs to be done thoroughly or not at all. We thus decided to split this article into a number of short papers, which will appear in the next couple of issues of *PlantLife*.

In this issue we will deal with an introduction to the asclepiad flower, while subsequent issues of *PlantLife* will contain articles on the sepals, petals, androecium, pollinaria, gynoecium, corona, pollination, fruits and seeds.

The structure of the Periplocaceae flower is, in many important ways, very different to that of the asclepiad flower and will not be dealt with in this series of articles.

The flower

Although appearing complex, the milkweed or Asclepiadaceae flower is really quite simple. Like many angiosperm flowers, it is composed of four alternating whorls of flower parts. According to the appendicular or foliar theory, these whorls are nothing more than highly modified types of leaves (see Radford *et al.* 1974, who give a good summary of the different theories concerning the origin of floral parts). The first outer whorl is the calyx which is made up of 5 sepals. The second whorl is the corolla which is made up of 5 petals. These two outer whorls are sterile. The next two inner whorls are fertile. The third whorl, the androecium, is made up of 5 stamens. This particular whorl contains the male gametes which are dispersed in the form of pollinia. When the different whorls that constitute a flower are each made up of a set of five parts (such as the above) they are referred to as being 5-merous or pentamerous. The last and fourth whorl in the flower is the gynoecium. In the Asclepiadaceae this is made up of two separate carpels (i.e., it is bicarpellate.) This state of unfused, or free carpels is called apocarpy and is unusual in a plant family like the Asclepiadaceae which is considered to be phylogenetically advanced. The Periplocaceae (Khadi-root family) and many Apocynaceae (Oleander family) species also have apocarpous ovaries. The gynoecial whorl contains the female gametes (egg cells) which are housed in structures called ovules. These ovules, if fertilized, are destined to become the well known asclepiad seeds topped with their coma of long white hairs. The ovaries develop into the fruit which is known as a follicle.

Most angiosperms, or flowering plants, have these four basic floral whorls (Fig. 1), although in some they become highly modified or, in others may double up, or even be lost. For instance, certain whorl parts may become reduced, e.g., the petals of the grass flower (Fig. 2) or they may also disappear altogether, e.g., certain *Euphorbia* species (Fig. 3). In other plants the four whorls may fuse together in various ways; this is called synorganization. This condition is important in the Asclepiadaceae which has the most synorganized flowers in the dicotyledons; its counterpart in the monocotyledons being the family Orchidaceae. If members or parts of the same whorl fuse together then it is called connate, e.g., the tubular corolla found in *Wahlenbergia* (Fig.4). If parts of different whorls fuse together then this is called adnate, such as in *Agapanthus* (Fig.5). Often both adnation and connation of various whorls and whorl parts occur in the same flower (as in the flowers of the Asclepiadaceae). It is this high degree of synorganization that makes the asclepiad flower appear so complex (Fig 6).

The figures below are called floral diagrams:

These are diagrammatic representations of floral parts and their relationship to each other.
Floral diagrams and floral formulae (not given here) help botanists understand the amazing floral diversity exhibited by Angiosperms.

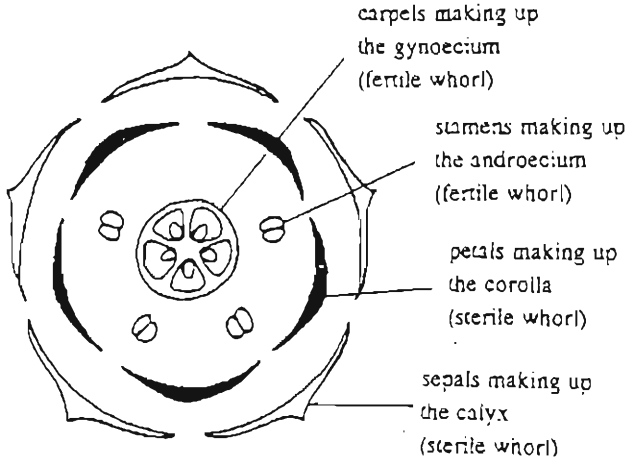

Figure 1: Stylized pentamerous flower.
Note how the four succesive whorls alternate

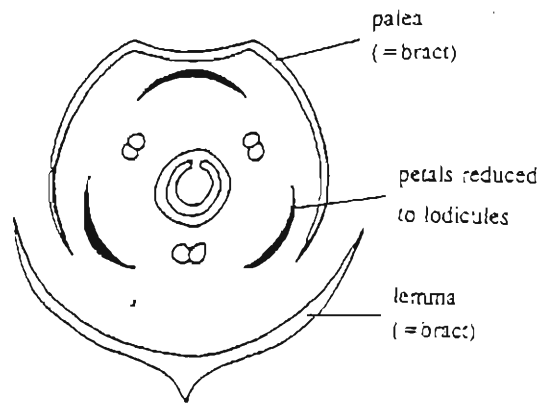

Figure 2: Grass flower showing
reduced petal whorl

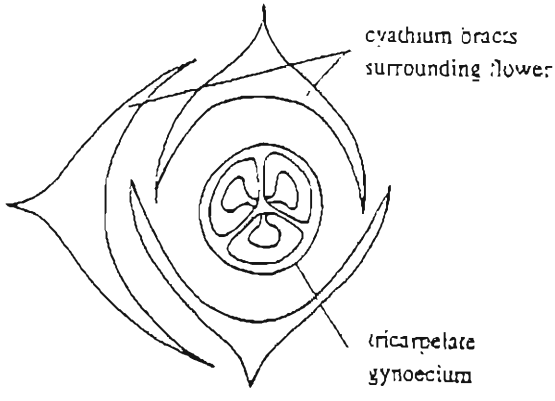

Figure 3: Stylized *Euphorbia* flower
showing that the sepal, petal and
staminal whorl have all disappeared

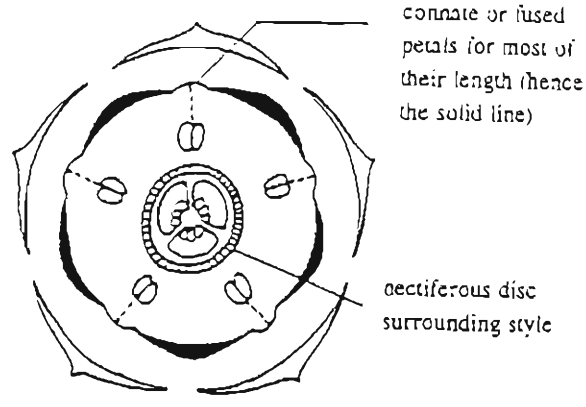

Figure 4. *Wahlenbergia flower* showing
connation of the petal whorl

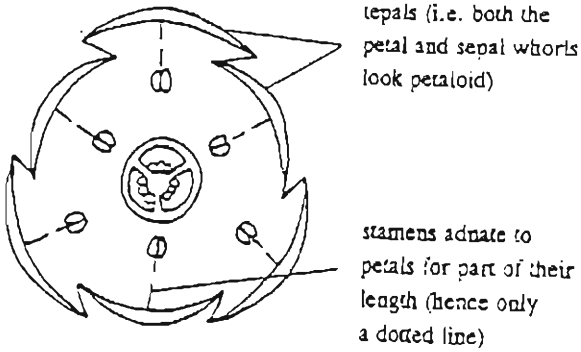

Figure 5: *Agapanthus* flower showing
adnation of staminal whorl to the
sepal and petal (=tepal) whorls.

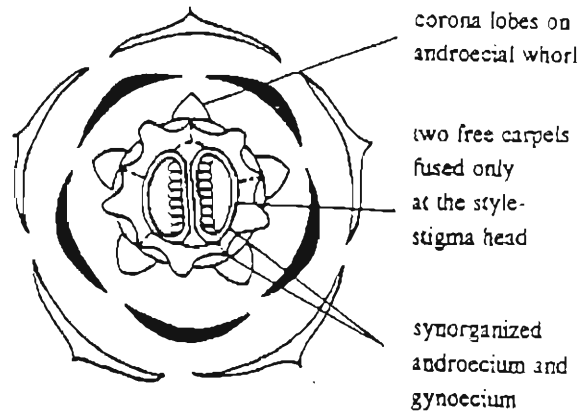

Figure 6: Stylized Asclepiadaceae flower
Note corona lobes, apocarpous gynoecium
and high degree of synorganisation

Occasionally some flower whorls will evolve appendages and, if these are associated with either the petals or stamens, they may be known as a corona (Fig.6). A corona may consist of either free parts, or lobes (as in many asclepiads), or these parts may be connate as in the corona of daffodils (*Narcissus* spp.). The whorls of some flowers may also produce nectaries of various sorts. These nectaries may be almost invisible to the naked eye (consisting only of patches of nectar secreting cells) as in most asclepiads or they may form distinct organs/lobes which may even become connate to form complete discs as in *Wahlenbergia* (Fig.4). As mentioned before, the carpels of the Asclepiadaceae are free (apocarpous) although usually in many higher flowering plants this whorl is connate, a condition called syncarpy. There are many types of syncarpous gynoecia, but these are not relevant to our story.

Armed with the above information we can now begin to investigate the complexities of the asclepiad or milkweed flower whorl by whorl. In the next issue we will discuss the calyx and the corolla in the family Asclepiadaceae.

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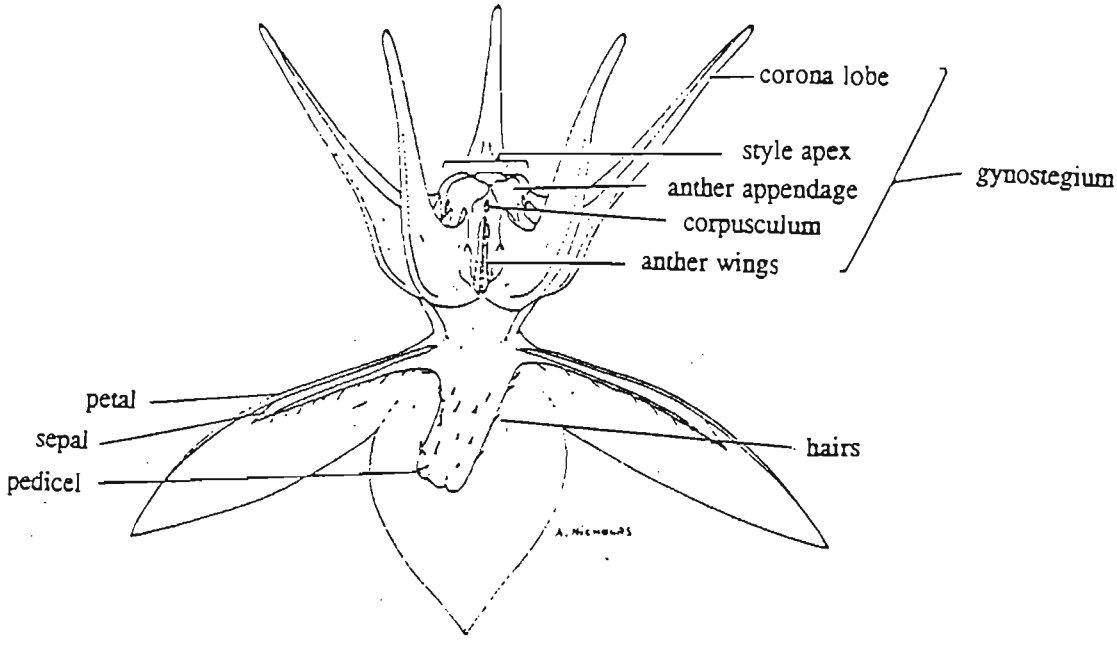


Flower of *Asclepias brevipes* (Schltr.) Schltr.

(X 25)

The structure of the Asclepiadaceae Flower Part II — the sterile whorls

Ashley Nicholas & Snowy Baijnath, Botany Department, University of Durban-Westville, Private Bag X54001, Durban 4001

INTRODUCTION

In the previous issue of *PlantLife* (No. 10) we presented an overview of the angiosperm flower, which in the higher plant families is basically composed of four alternating whorls; two sterile and two fertile. We then mentioned that the asclepiad flower is characterised by its high degree of synorganization, that is, when whorl parts fuse either with each other (connation) or to other whorls (adnation). This concept of synorganization must be borne in mind as we explore the asclepiad flower over the next few issues. In this issue we look at the two sterile whorls, namely the sepals (which form the calyx) and the petals (which form the corolla). Collectively these two sterile whorls may be known as the perianth.

1. THE CALYX/SEPALS

In the Asclepiadaceae this whorl, which is 5-merous, remains fairly constant in form, structure and colour. If anything, it is marked by the fact that it is taxonomically insignificant. Usually the sepals are greenish to greenish-purple in colour and lanceolate (= spear- or lance-shaped) or ovate in shape. They are normally free from each other, although in some species with large flowers (such as *Pachycarpus*) the bases of these parts may be fused.

2. THE COROLLA/PETALS

This whorl within the Asclepiadaceae (which is also 5-merous) is occasionally highly modified. As a result, this feature may be used to distinguish different genera or species, and it is often utilised in keys to identify to these plants.

Size

The size of the corolla varies from very small, ± 3mm long in *Aspidoglossum woodii*, to quite large, ± 140mm in *Stapelia gigantea*. Texture and thickness also varies; in fact, some succulent species have very fleshy petals.

Orientation

In many genera, such as *Sarcostemma* (in the sense of Bullock and not Holm) the petals may be free and spreading, a condition known as **rotate** (Figure 1a). Some rotate corollas, instead of spreading, may be held erect, although in many asclepiad genera they are usually **reflexed**. Sometimes it is just the tips of the petals, i.e. the lobes, that are reflexed, in other genera the entire corolla becomes reflexed, a good example of this state is present in *Asclepias eminens* (Figure 1b). In some species the petals are fairly flat, as in *Gomphocarpus fruticosus* (= *Asclepias fruticosa*, Figure 1c), while in others the margins are folded (we call this **revolute**). Margins may be only slightly revolute, e.g. *Schizoglossum ingomense* (Figure 1d) or markedly revolute, e.g. *Aspidoglossum connatum* (Figure 1e).

Connation

The petals may fused together completely, as in *Hoodia rosea* (Figure 2a), although such connation usually forms a corolla tube, as in the genus *Tavarasia angolensis* (e.g. *T. angolensis*, Figure 2b) and *Microloma incanum* (Figure 2c) or a bell-like structure, as in *Pachycarpus campanulatus* var. *sutherlandii* (Figure 2d), or even globose or spherical, as in *Brachystelma oianthum* (Figure 2e). *Ceropegia* needs special mention, for in this genus the petals are connate for most of their length, forming a long tube which may occasionally have a basal inflation, where the fertile whorls are housed. This basal inflation may have transparent windows

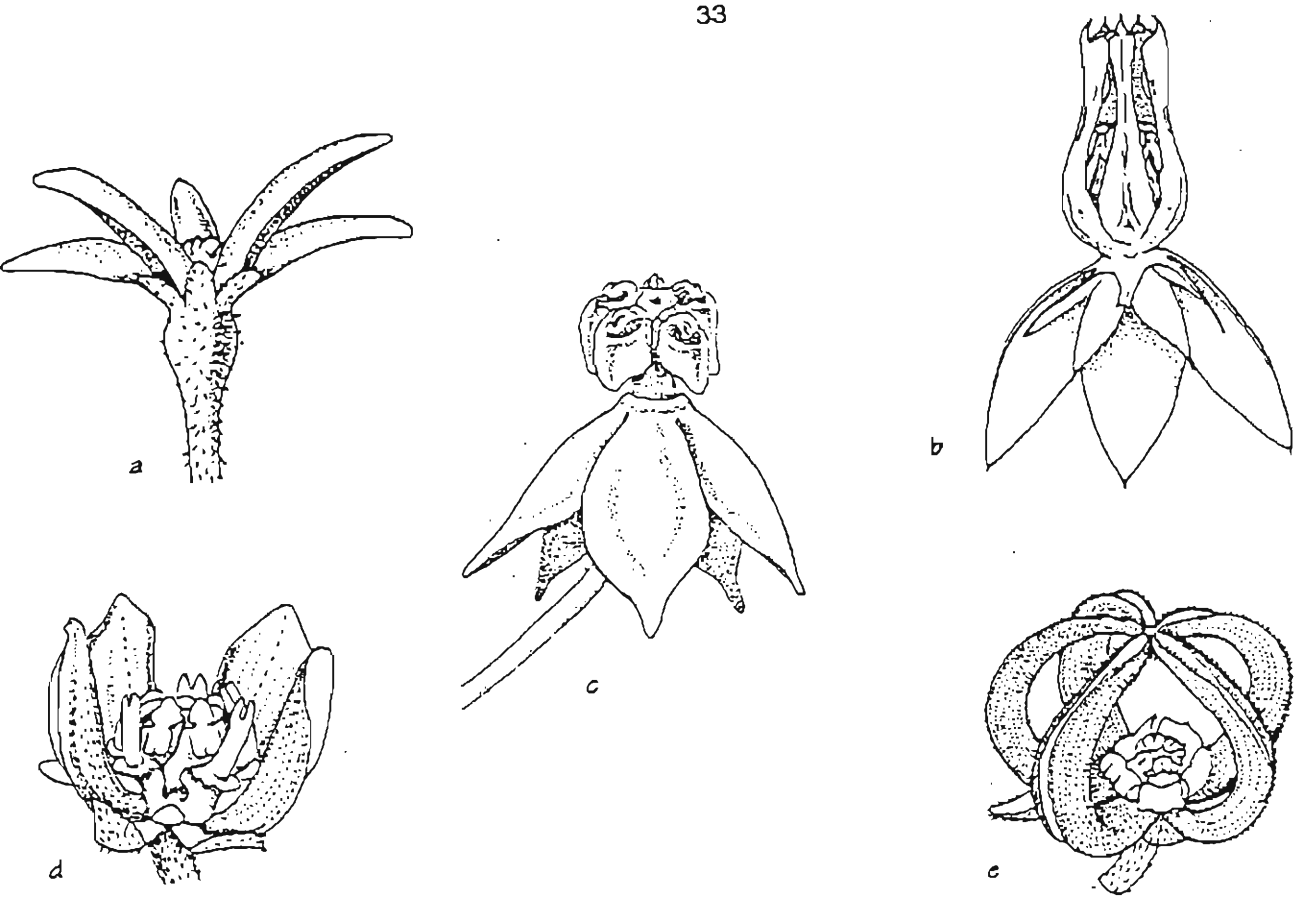


Figure 1: Corolla orientation. a. *Sarcostemma australe* (redrawn from Pearce 1986); b. *Asclepias eminens*; c. *Gomphocarpus fruticosus* (= *Asclepias fruticosa*); d. *Schizoglossum ingomense* (redrawn from Kupicha 1984); e. *Aspidoglossum connatum* (redrawn from Kupicha 1984).

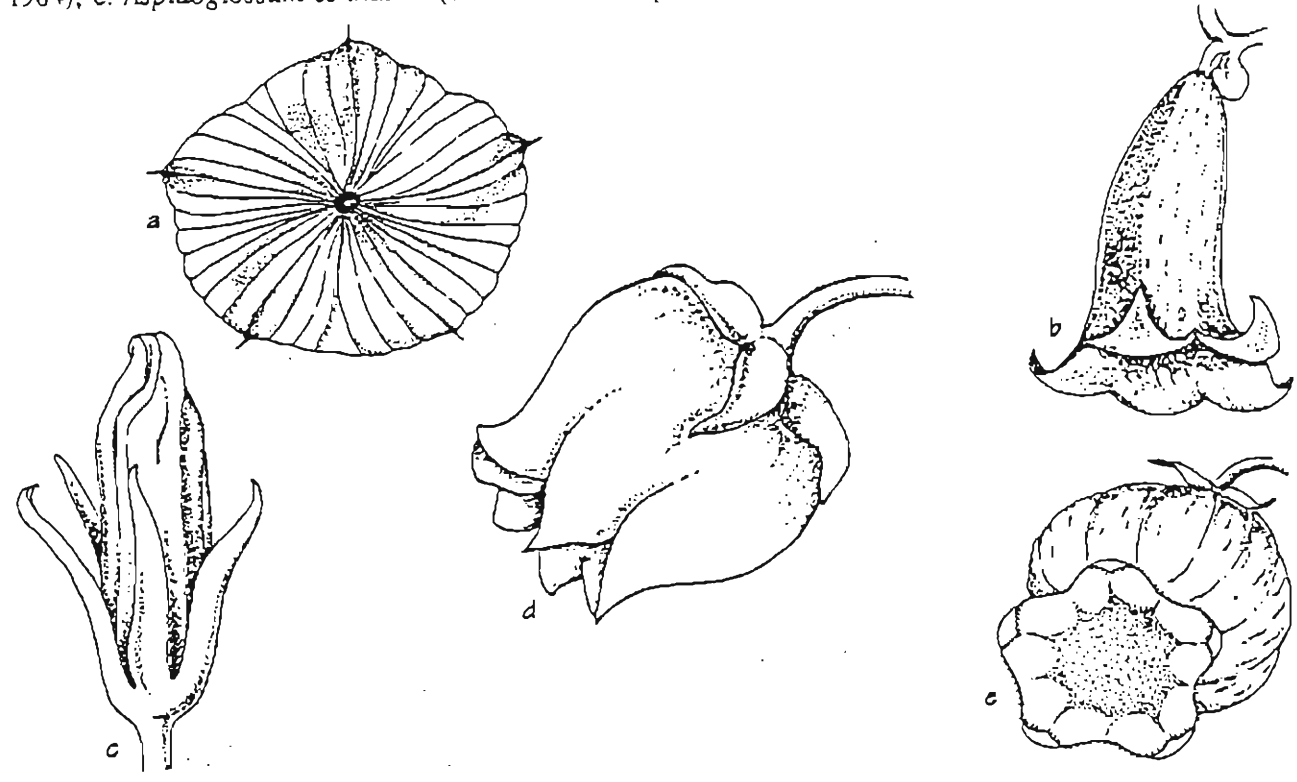


Figure 2: Corolla fusion or connation. a. *Hoodia rosea* (redrawn from Pole Evans 1936); b. *Tavarasia ngolensis* (redrawn from White & Sloane 1937); c. *Microloma incanum* (redrawn from Wanntorp 1988); . *Pachycarpus campanulatus* var. *sutherlandii* (redrawn from Smith 1988); *Brachystelma oianthum* Schltr. edrawn from Dyer 1980).

that let in light and so help promote pollination by insects trapped within the corolla tube. Near the tips, the petals once again become free, forming lobes. These lobes may remain free, as in *C. stapelliformis* subsp. *stapelliformis* (Figure 3a), although they often become connate again at their tips, thus forming a cage-like structure at the top of the corolla, as in *C. conrathii* (Figure 3b). This latter phenomenon is quite common in the Asclepiadaceae and may also be found in other genera such as *Schizoglossum*. However, in *Ceropegia* the story gets even more interesting because the point at which these lobes fuse may form a very elaborate canopy, e.g. *C. rendallii* (Figure 3c) or the lobes themselves can become exaggerated and elongated, e.g. *C. devecchii* (Figure 3d).

Petal outgrowths

• Corolline coronas

Sometimes the petal whorl may produce a whorl of small outgrowths or protrusions, called a corolline corona, as in *Microloma* and *Glossonema*. A corolline corona is also produced in many of the succulent genera, such as *Orbea*, but here it is known as an annulus (Figure 4a). The annulus consists of a raised ring of tissue that completely encircles the fertile whorls. The fascinating subject of coronas will be examined in another issue of *PlantLife*.

• Other outgrowths

In the succulent genus *Huernia* another unusual thing happens to the petal whorl (which is connate and spreading for most of its length). Triangular points are produced at the junctions or sinuses of the lobes; almost as if the whorl consisted of ten rather than five petals (Figure 4b).

Vestiture or ornamentation

There are usually two main types of vestiture found in the asclepiad flower, namely hairs and papillae.

• Hairs

Many species of Asclepiadaceae have no floral hairs (= **glabrous**) such as in the genus *Cynanchum*. In other species there may be a few long (usually multicellular) hairs, often on the outer, or **abaxial**, surface of the petal, as in *Aspidoglossum angustissimum* (Figure 5a). Some species of *Sisyranthus* produce a thick tangled beard of white hairs in the throat of the corolla (e.g. in *S. trichostomus*), in fact, the arrangement of hairs on the petals of *Sisyranthus* is used as one of the main diagnostic characters in this genus. Some genera, such as *Caralluma*, have many different types of hair: *C. stalagmifera* (Figure 5b) has strange stalagmite-shaped hairs (hence the specific name or epithet), *C. inverta* has long jointed hairs, while *C. lutea* has large vibratile ones (Figure 5c). In some species of *Stapelia* the hairs are almost reminiscent of those in animals and may form dense fur-like patches on the corolla, as in *S. pulvinata*. In fact, the petal surface of many stapeliads mimic animal skin. The hairs of these plants are long, thick and course, like animal hair, and the petal surface is wrinkled like hide. These plants also give off a fetid smell, apparently attempting to fool potential fly pollinators into believing that they are, in fact, dead rotting flesh. One gets quite a spooky feeling when investigating these almost "animal-like" plant tissues under the dissecting microscope. Lastly, under this heading, we must mention genera such as *Hoya* (which grows in Australasia). This genus has petals that are thick, waxy and appear to be made of plastic. *H. carnosa*, the Wax Plant, is commonly cultivated in South Africa.

• Papillae

Among the succulent genera papillae are often found. Translating directly from Latin, *papilla* means nipple-like (!), although these structures may, in fact, have quite a wide range of different shapes. They may even resemble sharp, pointed spines, as in *Huernia hystrix* — the porcupine *Huernia* (Figure 5d).

Colour

The immaculate (i.e. unspotted) corolla whorl in asclepiads comes in all the colours of the rainbow: *Aspidonepsis diploglossa* (yellow), *Cynanchum natalitium* (green), *Schizoglossum atropurpureum* subsp. *atropurpureum* (dark purple - almost black), *Microloma calycinum* (red), *Gomphocarpus fruticosus* (white), *Stapelia peglerae* (maroon), and the South American genus *Tweedia* (blue). Many species are, however, **maculate** (i.e. spotted or patched) and these petals may bear a mixture of colours. *Schizoglossum hamatum* has alternating vertical stripes of reddish brown and green, whereas *Rhytidocaulon macrolobus* has black and white stripes, like a Zebra. In *Calotropis procera* the petal colours do, what is known in the graphic arts business as a fountain fill, that is the colours grade from white to purple. Fountain fills of all sorts are quite common in the Asclepiadaceae. The colour patterns of some asclepiads are so complex that they almost defy description, such as the petal surface of *Asclepias oreophila* which appears to have irregular spots of violet on the outer surface (as if someone has spilt burgundy coloured wine onto a creamy grey coloured carpet), this background is then interlaced with purple coloured veins and finally the petal edge may be almost translucent and light purple in colour.

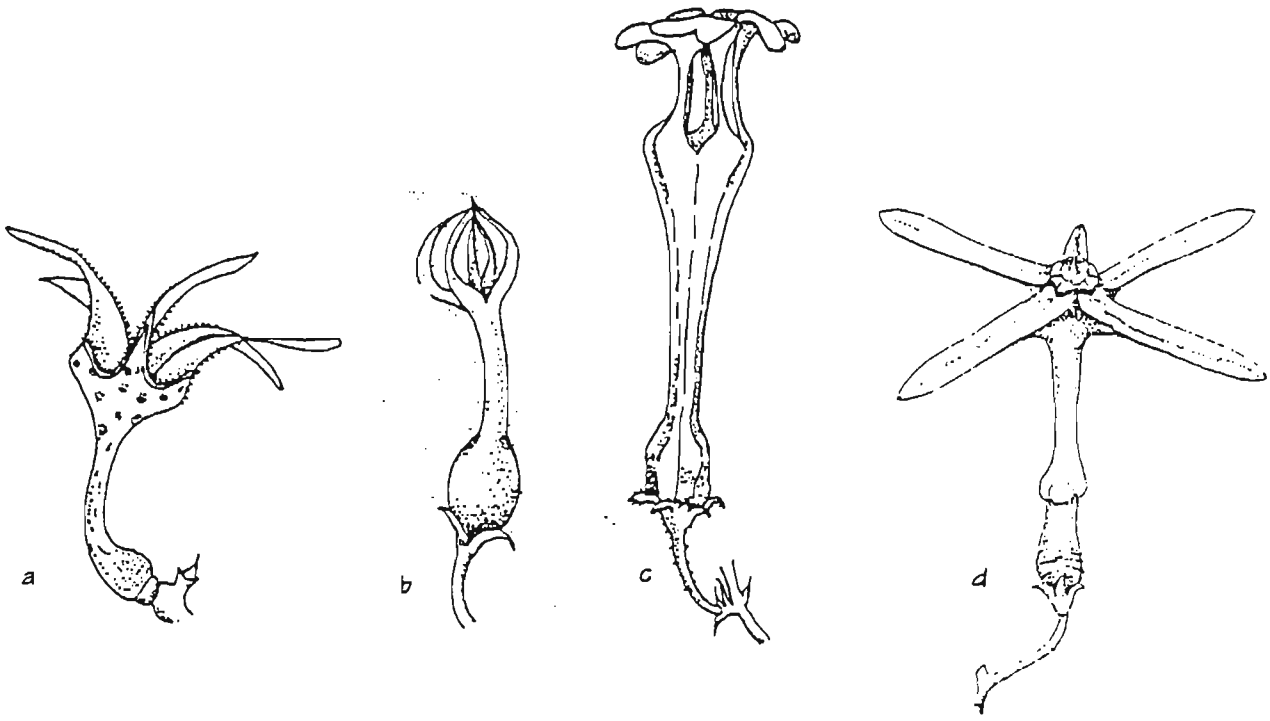
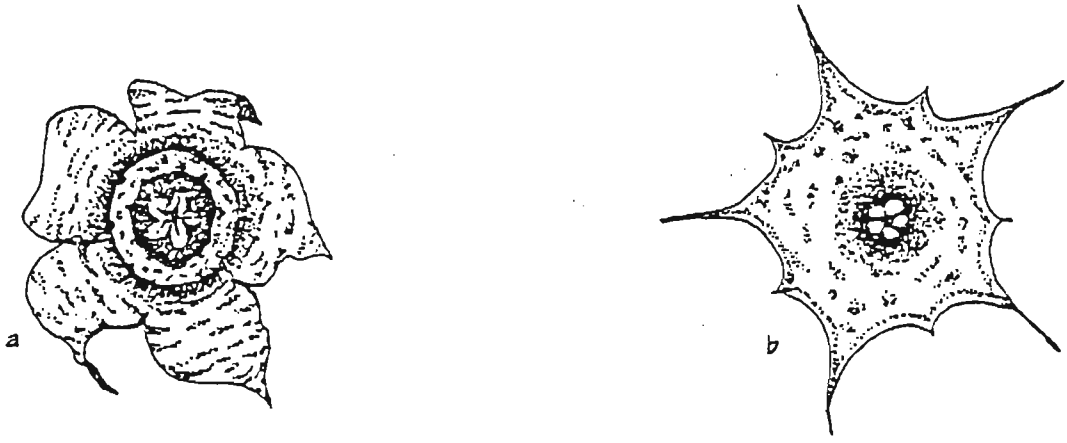


Figure 3: Variation in the connate corolla of the genus *Ceropegia*. a. *C. stapeliiformis* subsp. *stapeliiformis* (redrawn from Dyer 1980); b. *C. conrathii* (redrawn from Dyer 1980); c. *C. rendalii* (redrawn from Dyer 1980); d. *C. devechii*.



igure 4: Petal outgrowths. a. Annulus in *Orbea variegata*; b. Projections in petals sinuses in *Huernia rkii* (both redrawn from White & Sloane 1937).

In the next issue we will deal with the first of the fertile whorls - the androecium. It is at this point that structures in the Asclepiadaceae really begin to look unusual.

ACKNOWLEDGEMENTS

We would like to thank Heather Borchers for helping us with the line drawings.

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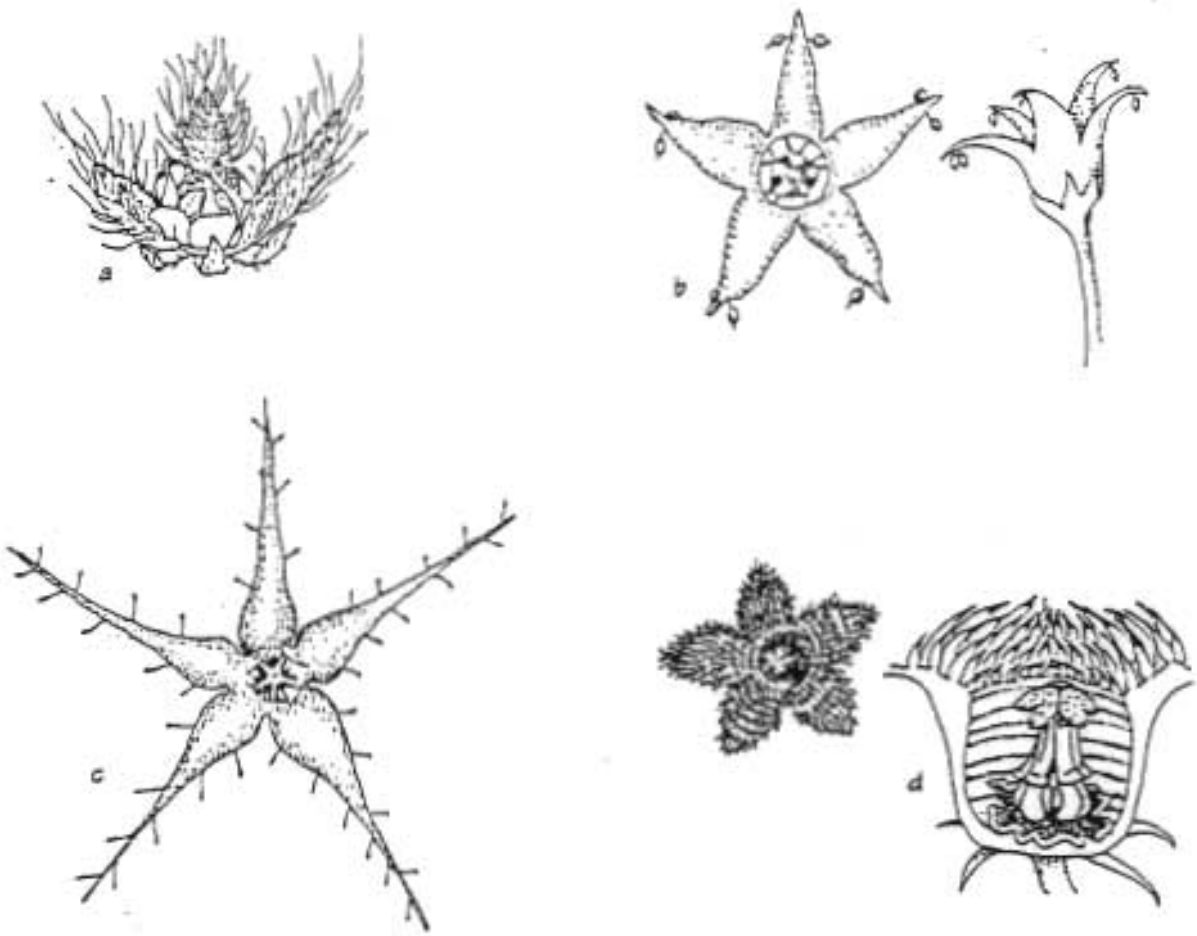

Figure 5: Corolla vestiture. Types of hairs. a. *Aspidoglossum angustissimum* (redrawn from Kupicha 1984); b. *Caralluma stalagmifera* (redrawn from White & Sloane 1937); c. *Caralluma lutea* (redrawn from Pole Evans 1936). Papillae. d. *Huernia hystrix* (redrawn from White & Sloane 1937).

The structure of the asclepiadaceae flower part III - the androecial whorl

Ashley Nicholas and Himansu Baijnath, Department of Botany, University of Durban-Westville, Private Bag X54001, Durban 4000

In the previous issue of *PlantLife* (No.11) we looked at the two outer sterile whorls of the Asclepiadaceae flower; in this issue we are going to examine the first of the fertile whorls. This, the male or (androecial whorl) is the most highly modified of the floral whorls. Compared with the stamens in other plants it looks very odd indeed! The stamens (the basic units of this whorl) are not only highly modified, they are also connate (see *PlantLife* no.10) as well as adnate to the gynoecium. Due to this extreme synorganisation, they form with the female whorl a common structure known as the **gynostegium** or **gynostegial column** (Figure 1).

The stamens

Lets begin by looking at the stamens themselves. In the "ordinary" non-Asclepiadaceae flower a stamen consists of three parts: a **filament**, the **anther** and the part of the filament supporting the anther called the **connective** (Figure 2).

In the Asclepiadaceae the filament has all but disappeared, although what remains may give rise to an outgrowth called a **corona**. The anthers and connective are expanded into a broad structure which is usually hardened or **cornified** on both of its lateral margins; these margins are known as **anther-wings**. Anther-wings may be narrow (e.g. *Aspidonepsis*) or quite broad and often beaked (e.g. *Pachycarpus*). They may even be notched along their length as in *Asclepias gibba* and its allies (Figures 2 and 3). Apically, the connective may or may not produce an **anther-appendage**. Usually, these appendages are ligulate (= tongue-like), opaque and lie on top of the style-stigma head, as in *Asclepias oreophila*. In some species the anther-appendages may become very large and even erect, as in *Asclepias expansa* and *A. praemorsa* (Figure 3). In *Asclepias woodii* they even contain unusual crystals.

The function of the anther-appendage is quite interesting, and only occurred to us after many years of studying the family. Basically, they act as a type of one-way valve, and in so doing prevent the anthers being torn away from the style-stigma head; a mutilation that would render the pollination mechanism ineffective. The gynostegium can be easily damaged because the anthers are only partially connected to the style-stigma head, as a result they can be torn away by the powerful legs of insects. The anther-appendages protect this weak point in the structure. Insect legs prancing about on top of the style-stigma head cannot accidentally get passed the overlapping, tile-like anther-appendages. However, insects with legs trapped in the gynostegial-groove can still pull them up and out,

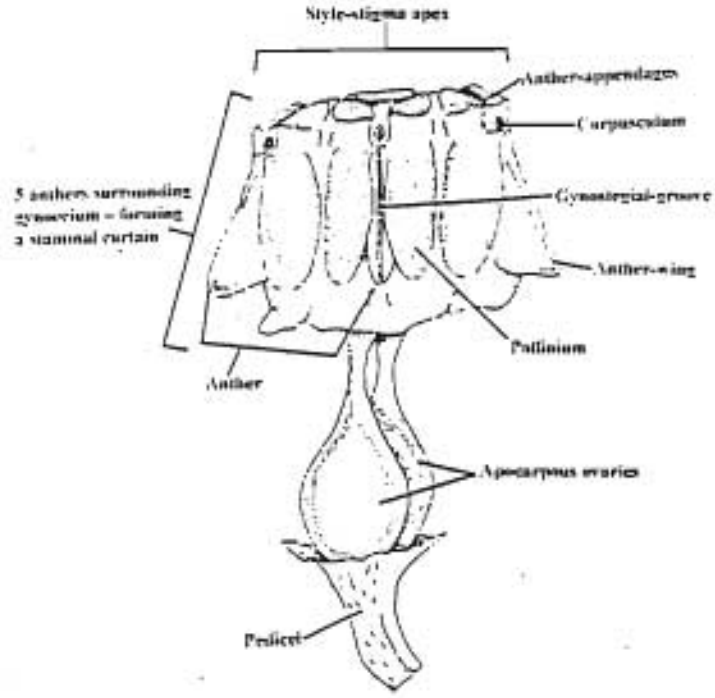

Figure 1: Gynostegial column, or gynostegium, with corona removed; X35. Redrawn from Nicholas, (1982).

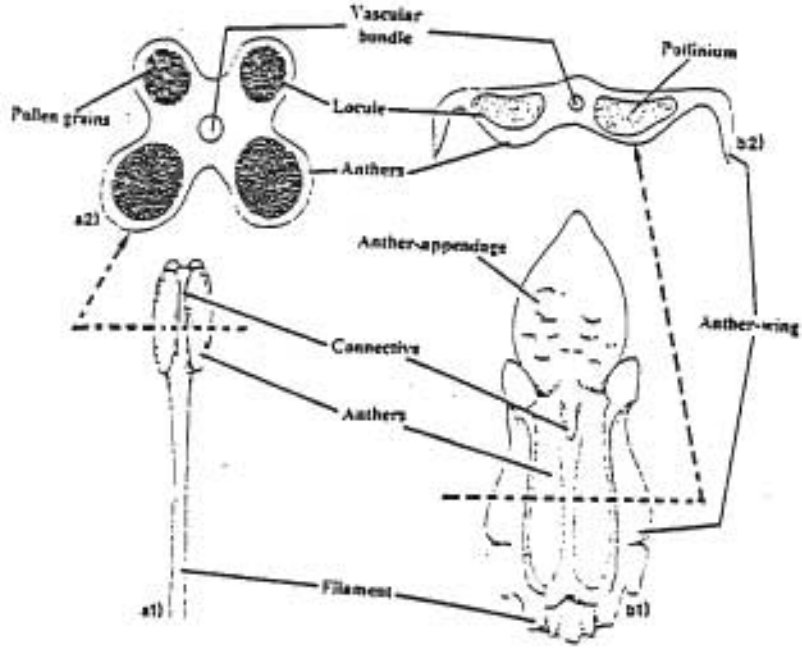

Figure 2: Stamen morphology & terminology a1) "Ordinary" non-Asclepiadaceae stamen; a2) T/s of anther showing dithecal, tetrasporangiate structure; b1) "Ordinary" Asclepiadaceae stamen; b2) T/s of anther showing dithecal, bisporangiate structure, and anther-wings.

passing the loose anther-appendages. This arrangement allows the gynostegium to be structurally firm, but also have enough elasticity to allow successful pollinaria removal (see later). As far as we are aware, this is the first time that an explanation of the possible function and action of the anther-appendage of the Asclepiadaceae has appeared in print. In species such as *Asclepias expansa*, the anther-appendages have taken on a secondary function, that of guiding the insect's legs towards the bottom of the gynostegial-groove where it will be temporarily trapped during pollinarium removal; in this way the anther-appendages of *A. expansa* help increase the chance of successful pollination.

The pollen

An unmodified stamen is usually dithecal (i.e. with two anther thecae) and tetrasporangiate (i.e. with 4 anther locules, two to each theca; it is in the locules that pollen is produced). These locules house the mature pollen grains. The *Asclepiadaceae are unusual in being dithecal, but having only one locule per theca* (i.e. bisporangiate); see Figure 2. An exception to this, however, is the subfamily Secamonoideae which has two locules per theca. There is still uncertainty whether the pollen in these locules are produced as monads (single grains) or tetrads (groups of four), but whatever the case, the grains of the entire locule eventually coalesce to form a waxy structure known as a pollinium (= singular). The pollinium of *Asclepias speciosa* is apparently made up of as many as 500 grains! Usually only two pollinia (= plural) are produced per anther in the subfamily Asclepiadoideae, and four pollinia per anther in the subfamily Secamonoideae. Pollinia occur in a variety of shapes and sizes (in *Secamone* they are minute, while in *Stathmostelma* they are very large); see Figure 4. They may be completely opaque (e.g. *Gomphocarpus*) or have variously pellucid margins (e.g. *Stapelia*). Sometimes the anther locules and pollinia they contain are pendulous (as in the tribe Asclepiadeae), horizontal to erect (as in the tribe Ceropegieae) or erect (as in the tribe Marsdenieae)*.

The point of germination of the pollen tubes from the pollinium also varies greatly, and can be diagnostic (Rao & Kumari 1979). You can see from the above discussion that the pollinium is a very important taxonomic/diagnostic character in the Asclepiadaceae (Schill & Jäkel, 1978).

In the Asclepiadoideae there are 10 pollinia per flower (in the Secamonoideae there are 20), and these are joined together in pairs. *The interesting thing, however, is that it is pairs from different anthers that are joined together and not the pollinia from the same anther!* As we shall see later there is a good reason for this. The pollinia are joined together by a complex, hardened structure known as the translator-apparatus. The translator-apparatus consists of translator-arms or caudicles (attached to each pollinium) and a corpusculum (which in turn connects the two translator-arms and their attached pollinia). The translator-apparatus plus its attached pollinia is collectively known as a pollinarium (= singular) or pollinaria (= plural); see figures 5 & 6. Translated from Latin, pollinarium means "the pollen house". The translator-arms may be long or short (and in *Secamone* even absent), and may also have small wings. This structure is strongly affected by the moisture conditions of its environment, and under the SEM (= Scanning Electron Microscope) the translator-arms of *Gomphocarpus* can be seen to contain hundreds of tiny pores on their under surface (Figure 6). This ability to change with the loss of water is important for pollination to succeed, because after removal from a flower the translator-apparatus dries out in flight and bends, causing the attached pollinia to re-orientate so that they are in a favourable position to be inserted into the stigmatic chamber of another flower of the same species. The corpusculum — meaning "small body" — is in effect a hardened clip ready to snap

* Tribal circumscription following Bullock, 1956.

onto the probing proboscis or fumbling leg of a pollinating insect (Wyatt 1978).

The staminal curtain

You will remember that the lateral edges of the anthers are cornified to form anther-wings. The anther-wings of adjacent anthers push together where they meet, and in so doing form the **gynostegial-groove** (sometimes also called the alar-fissure, or anther-slit). Because these structures form a rail on either side of a grooved track, they have been called "guide rails" by some botanists, however, the naming of structures based on their function can be misleading and cause confusion. As a result, scientific terms should rather be based on the structure of organs, thus making them unambiguous, and placing them and their associated organs in a framework that is confluent with their ontogeny (= development) and evolution. The term anther-wing is thus the preferred one for this structure and not the unscientific term "guide rails" (Bookman 1981). The corpusculum is located between adjacent anthers directly above the gynostegial-groove.

In this way, the five anthers encircle the gynoecium (to which they are apically attached) forming a structure known as the **staminal-curtain** (Figure 1). Lying side by side they produce five anther-slits each embraced by five pollinaria.

Conclusion

No other family, not even the orchids, possesses an androecium that rivals the complexity of that in the Aclepiadaceae. It is, indeed, one of the wonders of the plant world. The complexity of the staminal whorl of the ascleps is due to their insect obligated mode of pollination; a topic we will deal with later in this series. However, before then we must first look at the subject of coronas which will be the theme of the next installment.

Acknowledgements

We would like to thank Heather Borchers and Asok Rajh who helped with the drawings and photographic plate, respectively. The staff of the SEM Unit at the University of Durban-Westville are also thanked for their help and guidance.

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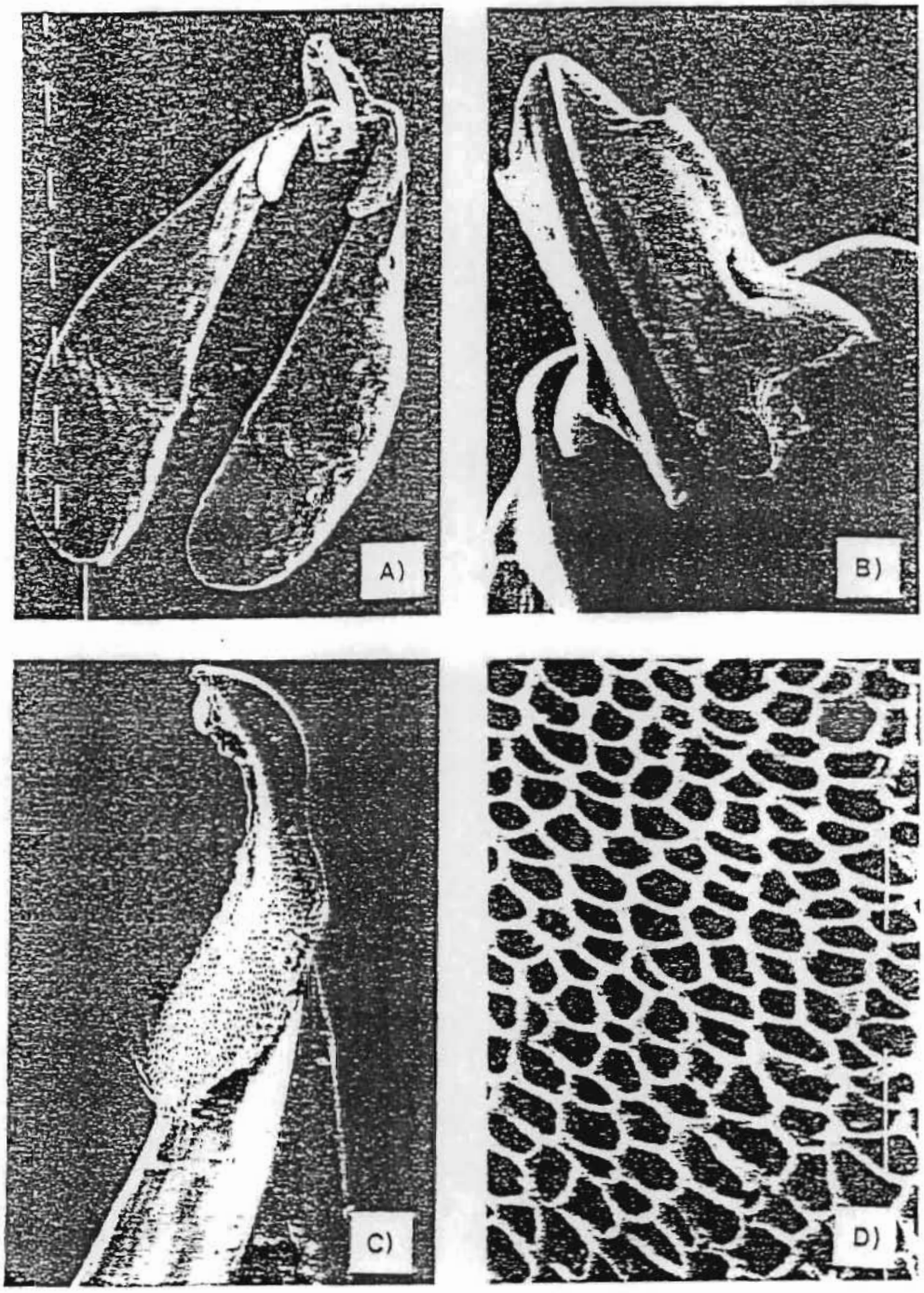

Figure 6: SEM of *Gomphocarpus physocarpus* pollinarium: a) Whole pollinarium, X80; b) Corpusculum, X320; c) Translator-arm showing porous structure, X320; d) Porous structure on translator-arm, X2500.

The structure of the asclepiadaceae flower part iv - the asclepiad corona

Ashley Nicholas and Himansu Baijnath, Department of Botany, University of Durban-Westville, Private Bag X54001, Durban 4000

INTRODUCTION

From the previous of *PlantLife* (N° 12) you would have gathered that the androecial, or staminal whorl is the most complex whorl in the asclepiad flower. The stamens are fused to form a staminal curtain (sometimes referred to as the staminal column), and that the stamens no longer look like conventional stamens. Even the pollen is different to other dicotyledonous pollen, being coalesced into waxy masses called pollinia and attached to each other in pairs. This is where we ended our article, but the complexity of the androecial whorl does not end here because, besides outgrowths in the form of anther-wings and anther appendages, the staminal whorl can sometimes also produce a quite spectacular outgrowth called the corona. *It is this special structure that we will deal with in this article.*

The term **corona** comes from Latin and means crown. This is an appropriate term for it is often the crowning glory of many asclepiad flowers. It should be mentioned at this point that although most asclepiads produce a corona some (such as the genus *Astephanus* and *Rhyssolobium*) do not; but this is a rare occurrence. Coronas may be outgrowths of the corolla whorl or the androecial whorl, and are incredibly variable - being small to big, simple to complex, and membranous to fleshy. It is no wonder that most students of the family find them mesmerizingly fascinating. Although coronas may vary greatly, they are nevertheless very species-specific (i.e. one species will only exhibit one type of corona). Usually variation within species is minimal (Figure 1A), however, occasionally some species, such as *Aspidonepsis reenensis*, show a degree of variation (Figure 1B).

COROLLINE CORONAS

Although we mention above that the corona is an out-growth of the staminal whorl, on some occasions it is an outgrowth of the petal whorl. These are known as **corolline coronas**. They are seldom very complex, and usually consist of "bumps" of various kinds; which may often be accompanied by tufts of hairs. They occur in both the Asclepiadaceae (e.g. *Gymnema*, *Microloma*), and the closely related family Periplocaceae - sometimes included in the Asclepiadaceae as the subfamily Periplocoideae - (e.g. *Ectadiopsis*, Figure 2). Some of the taxa of the tribe Stapelieae (e.g. certain *Orbea* species) have an annular type corolline corona that encircles the gynostegial column in the form of a raised rim on the sympetalous (= fused) corolla. In those flowers with rotate corollas (i.e.

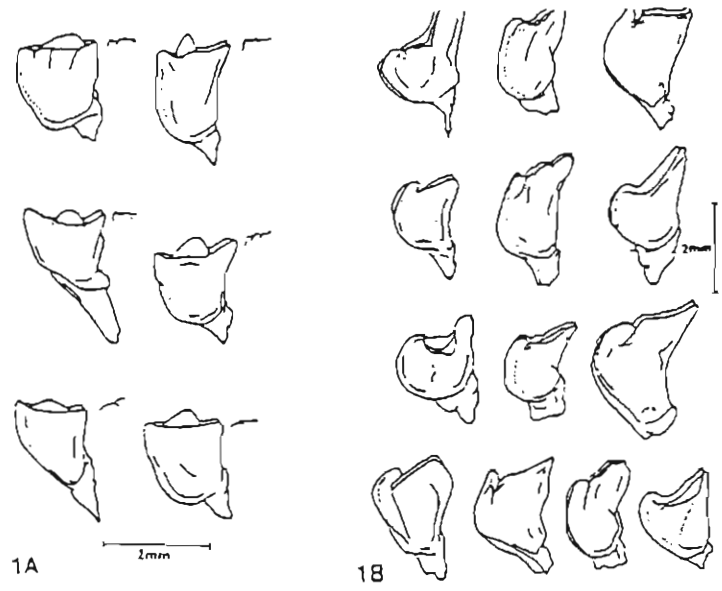

Figure 1. In-species corona lobe variation: 1A) corona lobes of *Aspidonepsis diploglossa* shows very little variation. from Nicholas (1987a); 1B) corona lobes of *Aspidonepsis reenensis* shows quite considerable variation. from Nicholas and Goyder (1992).

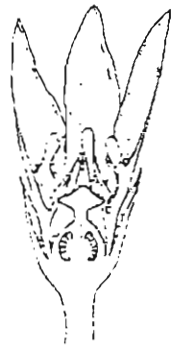

Figure 2. Corolline corona in *Ectadiopsis oblongifolia*. Redrawn from White (1962).

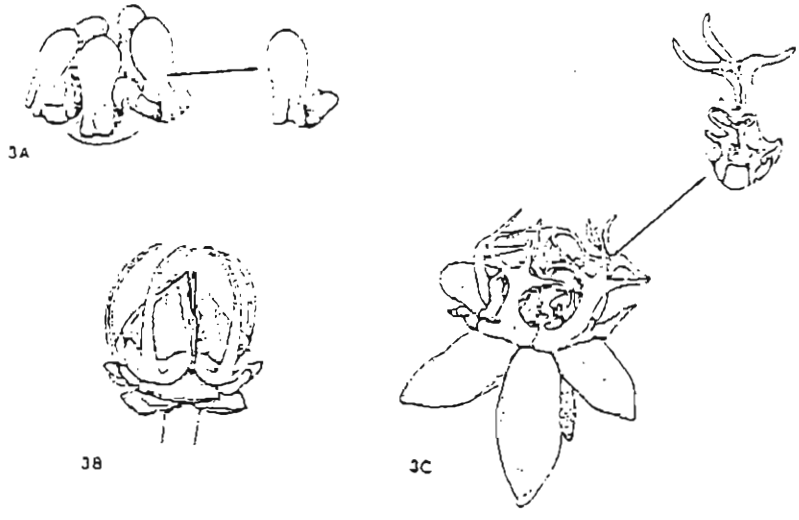

Figure 3. Staminal coronas - laminar types: 3A) Simple subtype. *Pachycarpus dealbatus*. redrawn from Smith (1988); 3B) Needle subtype. *Chlorocodon whitei*. redrawn from White (1962); 3C) Ornamented subtype. *Miraglossum superbum*. redrawn from Kupicha (1984).

spreading petals) the presence of corolline coronas are always accompanied by a staminal corona.

STAMINAL CORONAS

Lobes and rings

Staminal coronas may be produced as distinct lobes, or as a solid ring-like structure that surround the staminal curtain, in fact, the tribe Stapelieae exhibits both types in the same flower.

Corona whorl numbers

Staminal coronas may occur as a single whorl, or series, as is found in most, but not all, members of the tribe Asclepiadeae (e.g. *Gomphocarpus*), or in two whorls as in the tribe Stapelieae (e.g. *Ceropegia* and *Stapelia*). On very rare occasions three whorls of corona are produced (e.g. *Eustegia* and *Emicocarpus*). Although the origin of a single coronal whorl is easy to understand, the phylogenetic (= evolutionary) origin of double and triple whorls are more difficult to interpret.

CORONAS IN A SINGLE WHORL

Types

These types of staminal corona lobes are usually uniform or **monomorphic** (= of one form) in nature, and radially symmetrical. For this reason they can be placed into four different categories based on their structure. However, *these categories are artificial*, that is they do not correlate with taxonomic categories, and one genus may exhibit several different coronal types. This is because they are not phylogenetically congruous; the basis of this statement will be discussed in the next issue when we deal with the evolutionary trends that have governed the structural changes in coronas. However, they are useful categories that bring some sense of order to the wide variety of coronas that occur. Although often confluent at the base, synorganization does not occur in coronas occurring in a single whorl.

1. Laminar or ligulate types

This type can be further divided into three subtypes:

a) **Simple subtype:** These are blade-like (= **laminar**), or tongue-like (= **ligulate**), although they may possess thickened regions called keels (e.g. *Pachycarpus dealbatus*, Figure 3A).

b) **Needle subtype:** Simple types can be reduced to needle-like corona lobes, or corona lobes that are almost needle-like; as in *Chlorocodon whitei* (Figure 3B). These types may be associated with some ornamentation in the form of simple basal appendages.

c) **Ornamented subtype:** These may be simple or divided (**bifid** = divided in two, or **trifid** = divided in three), and are adorned with various appendages, teeth and keels. They can become very ornate and quite spectacular, as in the genus *Miraglossum* (Figure 3C). In fact, the name *Miraglossum* means extraordinary (= *mirus*) tongue (= *glosso*).

2. Cymbiform types

These can be of two subtypes:

a) **Simple subtype:** These are slipper-like or boat-like (= **cymbiform**) with a central sinus or cavity (as in some *Asclepias* species, Figure 4A). They are broader than tall. More advanced forms of this subtype have proximal and distal appendages and/or a central horn-like process or appendage, as in the genus *Aspidonepsis* (Figure 4B).

b) **Turriform subtype:** In this subtype the lobe is tower-like, and the sinus has been reduced to a narrow channel; e.g. *Asclepias eminens* (Figure 4C), although central appendages may persist in some of these as in the Eastern Cape species *Asclepias compressidens*. These lobes are taller than broad.

3. Globular or scale-like types

These are small, simple, and globular or almost globular structures, e.g. *Xysmalobium* (Figures 5A and 5B).

4. Podoform types

Podoform (= foot-like) types are similar to globular types in that they are solid structures. However, unlike globular types they are usually

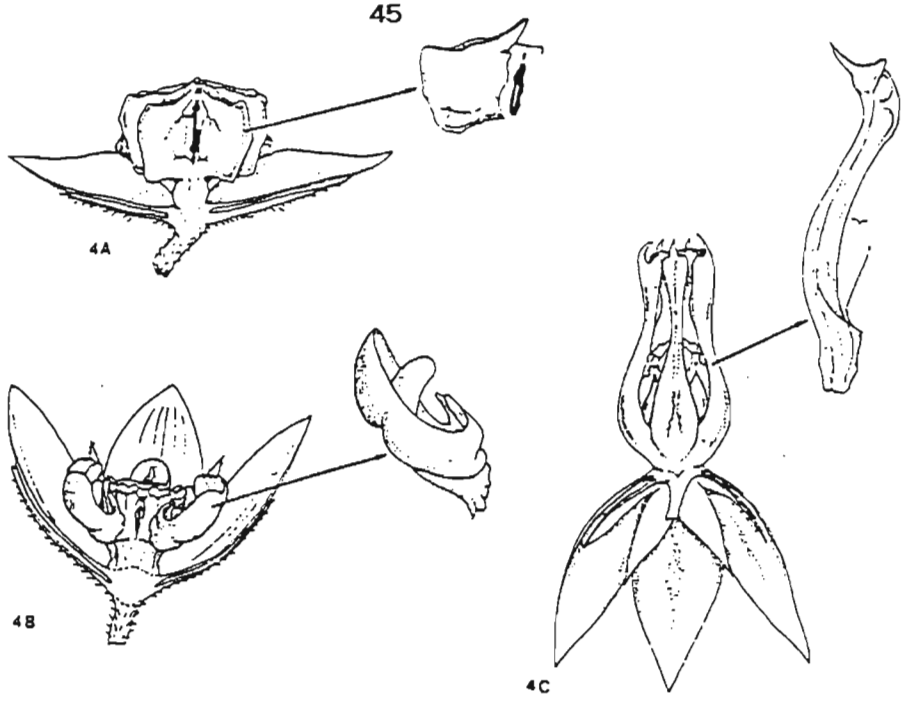

Figure 4. Staminal coronas - cymbiform types: 4A) simple subtypes without appendages, *Asclepias patens*, redrawn from Nicholas (1987b); 4B) simple subtype with appendages, *Aspidonepsis flava*, from Nicholas and Goyder (1992); 4C) turriform subtype, *Asclepias eminens*, redrawn from Nicholas (1981).

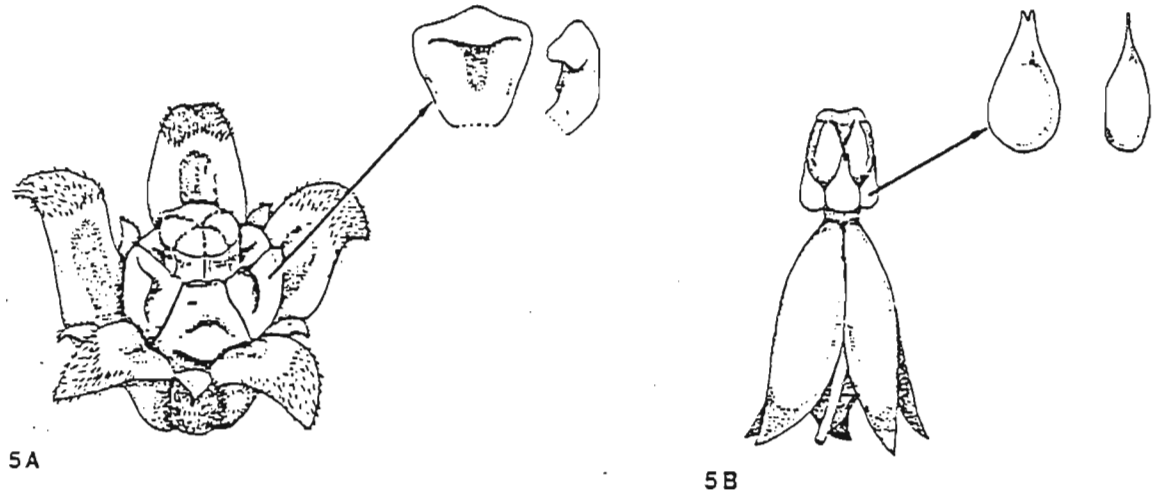

Figure 5 Staminal coronas - globular or scale types: 5A) *Xysmalobium stockenstroomense*, redrawn from Langley (1980); 5B) *X. involucratum*, redrawn from Langley (1980).

larger and less globose in shape. These types may evolve a central sinus thus becoming cymbiform, or become appendaged and therefore to a degree ornamented, or they may do both; all such trends can be seen in the large Australasian genus *Hoya* (± 200 species) of which the commonly grown Wax Plant (*Hoya carnosa*) is an example.

CORONAS IN DOUBLE WHORLS

In these types the outer whorl differs from the inner one, that is they are dimorphic (= of two forms). These types can be very complex. Sometimes the two coronal series are distinct, as in *Sarcostemma* in which the outer corona embraces the base of the inner corona, but usually they are fused and almost resemble one structure. The outer coronal whorl is usually annular and may be cup-like to trough-like (Figure 7A), or bear appendages which are often bifid (Figure 7B), or curve over the top of the style-stigma head. The inner corona almost always consists of five long individual lobes that may be needle-like, conical, or strap-like (Figure 7C). Often these are bifid or divided into two parts or appendages; one being erect, the other projecting over the style-stigma head.

Synorganization

In double corona whorls two types of fusion may occur:

1. The lobes of the outer whorl fuse together (= **connation**), while the inner whorl is free; e.g. *Oxystelma*.
2. The outer whorl fuses to the inner whorl (= **adnation**). If both whorls are made up of uniform corona lobes then they fuse to form a uniform structure called the **coronal curtain** (e.g. *Fockea* and *Cynanchum*, Figures 6A and 6B). If the whorls are dissimilar (dimorphic) then the corona can become very complex indeed, as is seen in *Stapelia* and *Brachystelma*. This second type is more common.

CORONAS IN TRIPLE WHORLS

Coronas in triple whorls are usually **trimorphic** (= of three different forms), once again each whorl is uniform and symmetrical. Often whorls do not differ very greatly from each other (e.g. *Eustegia*). Synorganization can also occur.

COROLLINE & STAMINAL CORONA MIX

Some species (e.g. certain *Orbea* species) have both a corolline corona and a staminal corona.

ACKNOWLEDGMENTS

We would like to thank Heather Borchers for helping us with the drawings.

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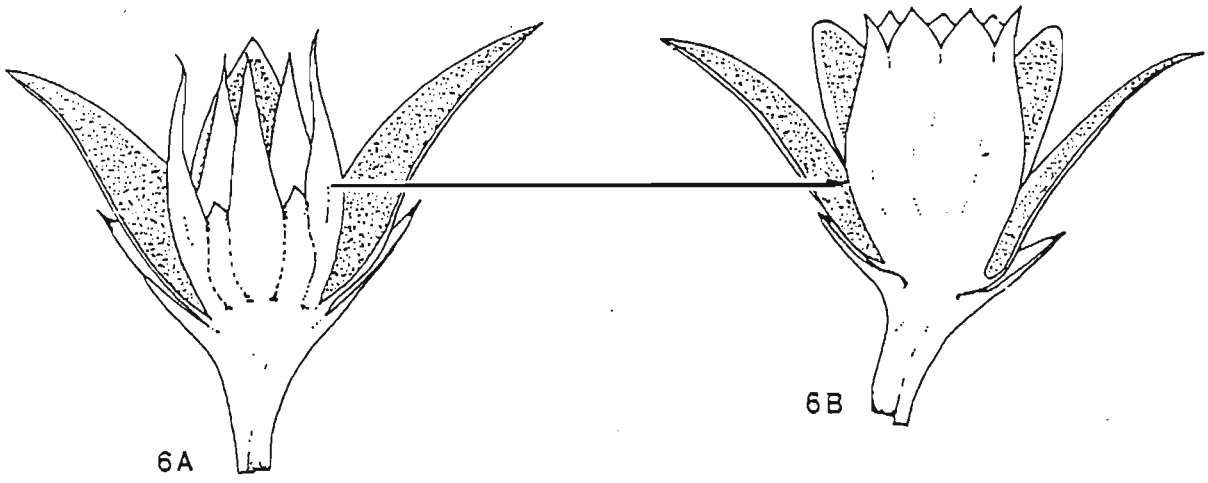


Figure 6. **Staminal corona - synorganization**: 6A) Species with more or less free corona lobes. *Cynanchum obtusifolium*; 6B) Species with corona lobes fused. *C. natalitium*.

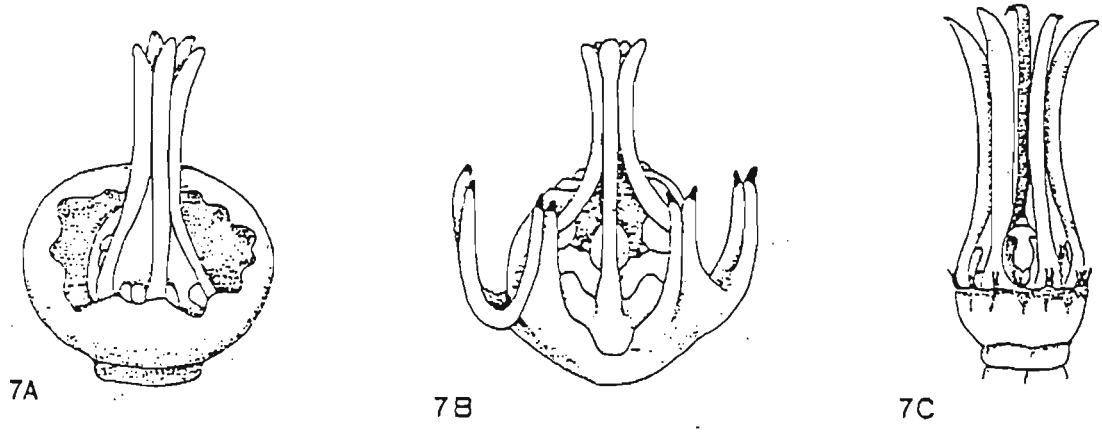


Figure 7. **Staminal coronas - double corona whorls types:** 7A) Outer corona cup- or trough-like. *Ceropegia fortuita*; 7B) Outer corona with bifid appendages. *C. filiformis*; 7C) Strap-like inner corona lobes. *C. sandersonii*. All redrawn from Dyer (1980).

The structure of the asclepiadaceae flower, part v: function and evolution of the corona

Ashley Nicholas and Himansu Baijnath,
University of Durban-Westville, Private Bag X54001, Durban 4000

In the previous issue. *(PlantLife* 13) the structure of the asclepiad corona was discussed. In this issue we look at the function and evolution of this fascinating structure.

The function of the corona

The corona has two main functions:

1. Mechanical aid to help in successful pollination.
2. As a corollary to the production and storage of nectar.

Corona lobes are usually associated with nectar-producing glands. and the cymbiform types in particular are ideal as a retainer for this sugary reward. Fortunately, some work has been done on the nectar of this family (Wyatt & Broyles 1994). Given the fact that pollinators are, in most cases, fairly species-specific and that pollinators range from Hymenoptera (bees and wasps) to Lepidoptera (butterflies and moths) to Diptera (flies), one would expect the composition and quantity of the nectar (as well as olfactory attractants) to vary within the family. However, the fact that some asclepiads do not have coronas and still produce nectar would suggest that the primary reason for the evolution of the corona is as a mechanical aid to help increase the chances of successful pollination. The Asclepiadaceae flower has to ensure that a pollinator's leg, or proboscis, gets caught in the gynostegial groove TWICE (once to withdraw a pollinarium and the second time to deposit it) if pollination is to succeed! Coronas help to guide a visiting pollinator's leg, or proboscis, to the base of the gynostegial groove. and ensures that the easiest way to removing it is by sliding it up this groove.

Phylogenetic trends and structural evolution within single corona whorls

Although coronas are species-specific it is unfortunate that taxonomists of the past used to put so much importance on the structure of the corona (a process known as weighting) when defining genera in the family. This is not surprising, however, because it is only in this century that phylogenetic (= evolutionary) processes have become widely understood and appreciated; especially the evolution of particular characters (known as structural evolution). As a result, before the 1900's asclepiadologists placed all species possessing a corona lobe sinus into the genus *Asclepias*, all those that were reduced to a blob into the genus *Xysmaloöbium*. and so on. When quite unrelated plants evolve parts that look similar, such parts are said to be analogous or, in cladistic terms, homoplasious. This is also known as false similarity. When aiming to produce a phylogenetic classification* taxonomists must look for, and not be fooled by, such false similarity. It is for this reason that we are now looking critically at the evolution of the corona

* As phylogenetic classifications are synthetic and heuristic and, therefore, carry more information, they are to be preferred over artificial classifications. More importantly such phylogenetic classifications are more predictive.

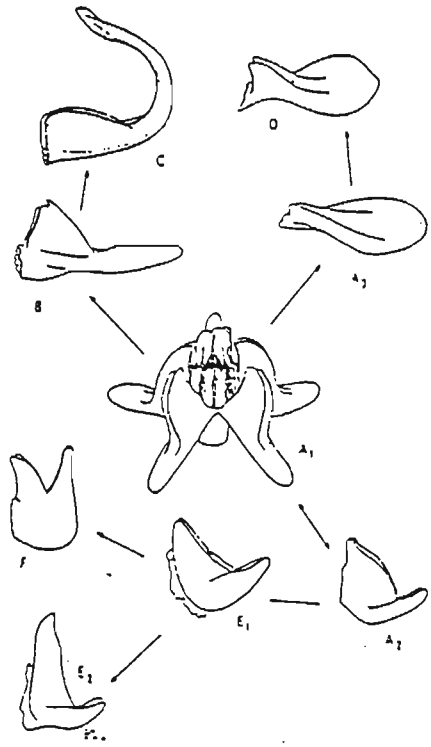


Figure 1. Postulated corona lobe evolution in *Pachycarpus* section *Campanulati* showing trends towards both ornamented and cymbiform types coronas. A1, A2, A3. *P. campanulatus* var. *sutherlandii*; B. *P. campanulatus* var. *campanulatus*; C. *P. linearis*; D. *P. rostratus*; E1, E2. *P. stelliceps*; F. *P. suaveolens*, from Nicholas & Goyder (1990).

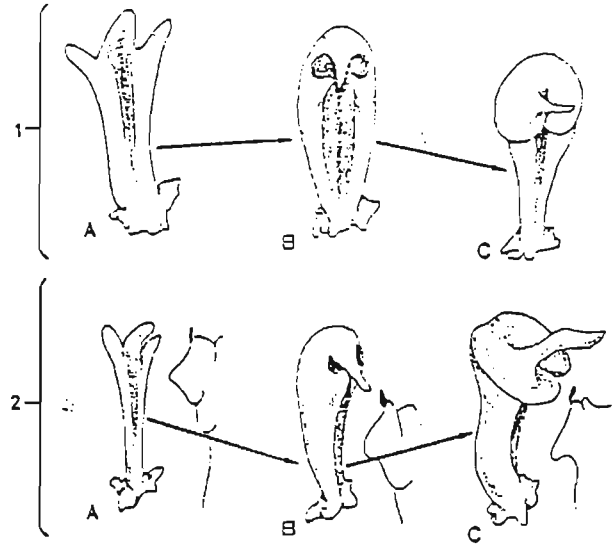


Figure 2. Postulated corona lobe evolution of *Pentarrhinum* from a *Cynanchum*-like ancestor. 1. Oblique front view; 2. Oblique side view: A. *Cynanchum somaliense*; B. *Pentarrhinum abyssinicum*; C. *Pentarrhinum insipidum*, from Liede and Nicholas (1992).

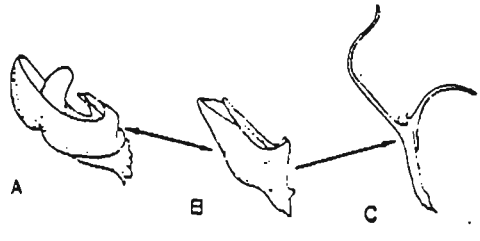
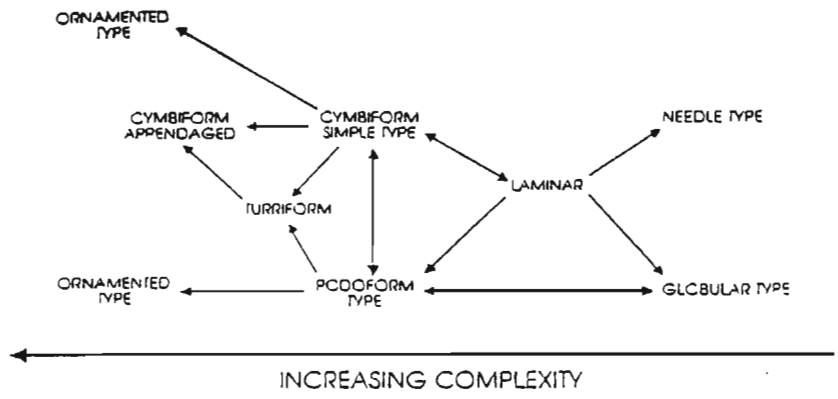


Figure 3. Postulated corona lobe evolution of *Aspidoglossum* from an *Aspidonepsis*-like ancestor. A. *Aspidonepsis flava*; B. *Aspidoglossum delagoense*; C. *Aspidoglossum biflorum*, from Nicholas and Goyder (1992).



lobe (amongst other characters) in the Asclepiadaceae. Recent investigations (Nicholas & Goyder, 1990) have shown that although the primitive type of corona in the genus *Pachycarpus* is laminar they have, in section *Campanulati*, evolved into advanced cymbiform types. It was for this reason that *Pachycarpus suaveolens* (which possess a corona lobe sinus) was mistakenly placed in the genus *Asclepias* (Figure 1). *Pachycarpus* section *Pachycarpus* has evolved both cymbiform types (*Pachycarpus schweinfurthii*) and globulose types (*Pachycarpus asperifolius*). Likewise the turriform type of corona exhibited by *Pentarrhinum insipidum* seems to have evolved from the laminar type exhibited by the species *Cynanchum somaliense* (Figure 2). Finally, the evolution of the sister genera *Aspidonepsis* and *Aspidoglossum* show a move from the cymbiform type to the ornamented type (Figure 3).

Phylogenetic trends and structural evolution within mixed double and triple corona whorls

The origin of the triple corona as exhibited by *Eustegia* is less obvious, although it can be seen how the double corona lobe possibly evolved from this type, either by reduction or synorganization. The question now arises "what is the most primitive type of corona?" This is, unfortunately, a pivotal question to which we as yet do not have the answer - any ideas? For a totally different, and more scholarly, discussion on the morphology and evolution of the corona, readers should refer to Kunze (1990) and Liede & Kunze (1993).

Conclusion

The corona's of the Asclepiadaceae are amongst the most amazing and unique devices ever invented by plants to ensure successful reproduction. This concludes our look at the androecial whorl of the asclepiad flower (which verge on mind boggling in its complexity), in the next issue we shall look at the last of the whorls, the gynoecium, and its products - the fruit and the seed.

Acknowledgements

We would like to thank Heather Borchers for helping us with the drawings.

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The structure of the asclepiadaceae flower part vi: the gynoecium

(with comments on pollination)

Ashley Nicholas and Himansu Baijnath,
University of Durban-Westville, Private Bag X54001, Durban 4000

Two years have passed since we started this series on the structure of the Asclepiadaceae flower, and in this issue we have finally got around to looking at the last floral whorl: the **gynoecium**. This is, of course, one of the two fertile whorls that make up the flower. The first of these is the **androecium** or male whorl, the second or inner of these the gynoecium or female whorl. These terms are Greek in origin: **androecium** meaning male house (*andro-* = male, *-oecium* = house), and gynoecium meaning female house (*gyno-* = female). Interestingly, it is from the suffix *-oecium* that we also get *Oecology* or **ecology**: the study of plant community structure and function.

THE GYNOECIUM

Unlike the other three whorls which are all **pentamerous**, or made of five parts (*penta* = five & *-merus* = parts), the gynoecium is **bicarpellate** or made of two carpels. These are free or **apocarpous** at the base (in the region of the ovary and lower part of the style) and **connate** (joined) at the top into a structure known as the **style-stigma head**. The gynoecium is superior (sitting above the other whorls), but in some instances sub-inferior (Figure 1).

The Style-Stigma Head

This structure is swollen and **adnate** (joined) or at least connivent (pressed against) the top of the stamens. If not covered by the anther appendages it is exposed to the outside of the flower on its upper surface (Figure 1). Most times this surface is flat with a shallow dimple at the top, the raised outside rim consisting of five small bumps on which the five corpuscula sit. Sometimes, however, it may form a cone-like structure that projects into the air, and which may be grooved or shortly bifid (*bi* = two, *-fidus* = divided) at the apex. Occasionally these projections can become quite ornate, forming a short to long stem usually ending in two branches (e.g. *Ibatia*), or in the case of *Schistogyne* as many as seven branches, while in *Calostigma* there is a cup-shaped frilly structure below the two short apical branches (Figure 2). The genus *Secamone* shows a wide variety of style-stigma head appendage types (Figure 3). In *Rothrockia* and *Pachycarpus rostratus* there are lateral rather than apical appendages, while in our local species *Cordylogyne globosa* the short stem is terminated by a small **globose** (= round) head. The function of these structures is not certain, perhaps like the corona they help guide the pollinating insect's legs or proboscis towards the gynostegial groove, or as suggested by Good (1974) maybe they act, like the coronas of the Stapelieae and *Barjonia*, as pseudostamens and pseudocarpels so that to a visiting insect the odd asclepiad flower at least looks like a "normal flower" (insect pollinators can be pretty fussy). Possibly these structures have different functions in different species?

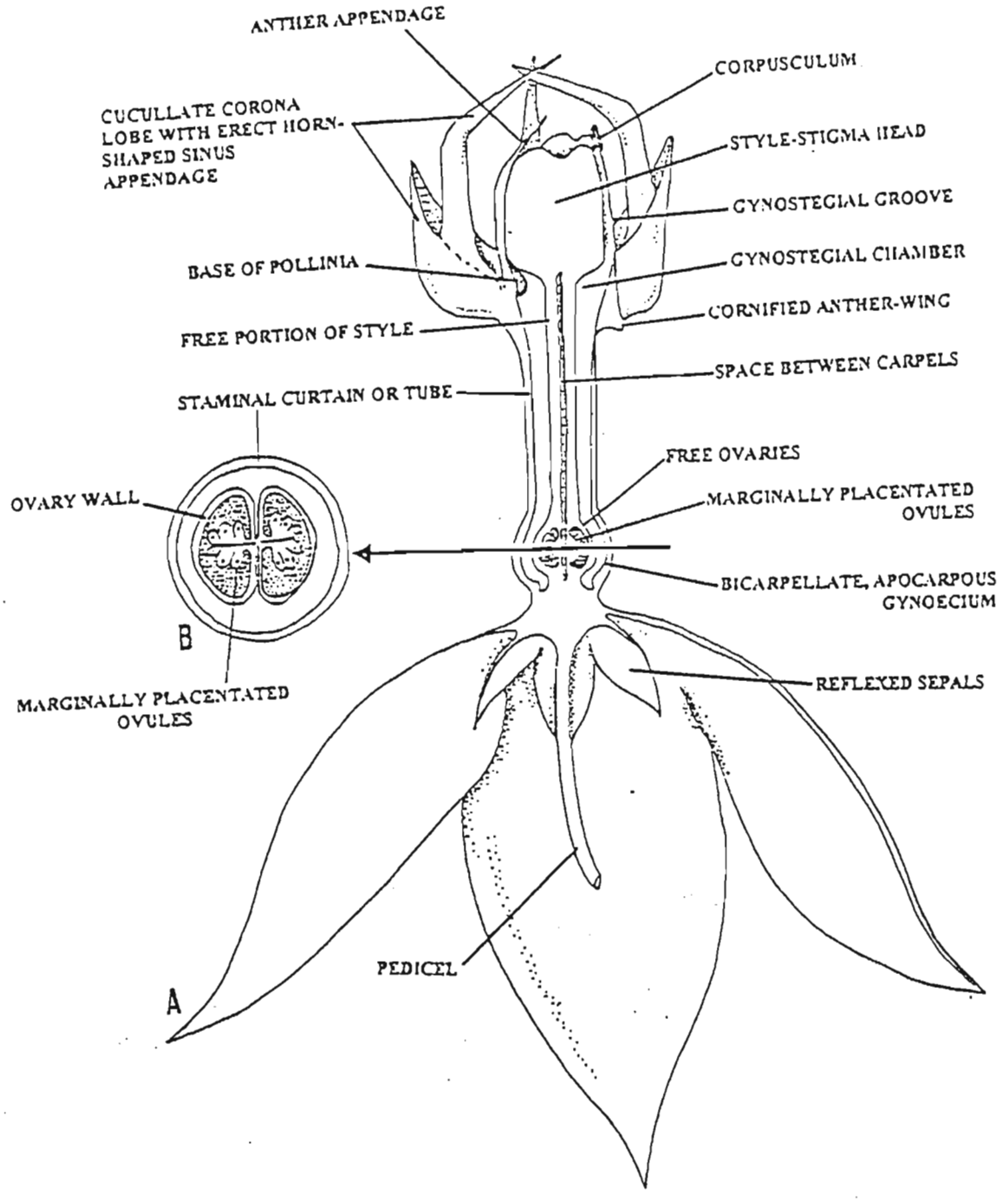

Figure 1. Half flower drawing of *Asclepias curassavica* showing the superior, apocarpous gynoecium, style-stigma head and marginally arranged ovules on a protruding placenta: A. Longitudinal section of whole flower, B. Cross section of flower at the level of the ovary.

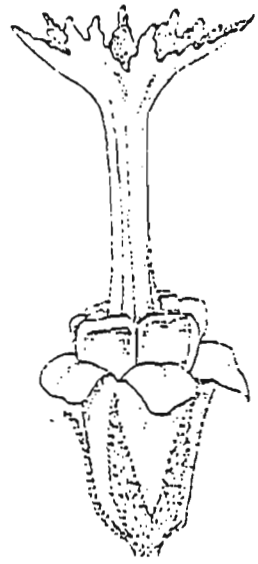

Figure 2. Flower of *Calostigma insigne* from Brazil, showing its ornate and unsual style-stigma head appendage. Redrawn from Decaisne (1838).

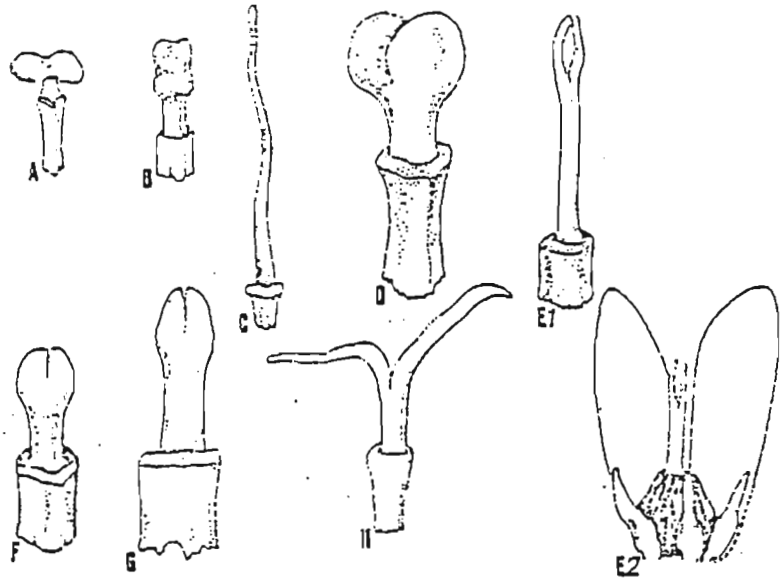

Figure 3. A range of different style-stigma head appendages exhibited by the genus *Secamone*: A. *S. rodriguesiana*; B. *S. mimutifolia*, C. *S. stylosa*, D. *S. geayi*, E. *S. australis* 1. style-stigma head appendage. 2. whole flower with front petals removed. F. *S. turceolata*., G. *S. cloiselii*. H. *S. reticulata*. Redrawn from Klackenberg (1992).

The Stigma

Besides forming a "curtain rail" on which the staminal curtain can hang, the style-stigma head also contains the stigmatic surface on which pollen can germinate and effect fertilization of the ovules in the ovary. In the literature the stigma is said to be composed of five patches which lie on the side or under surface of the style-stigma head in positions below the five gynostegial grooves (remember it is into these grooves and their associated **gynostegial chambers** that the pollinia from another flower will be inserted during pollination). However, in our experience, these stigmatic patches can rarely be seen either with the naked eye or dissecting microscope, their existence, to a large extent, has been universally inferred from a few known cases. In a sense, they are apocryphal rather than empirical. Similar sentiments are expressed by Good (1974) who also points out that it is strange that a bicarpellate gynoecium (which in theory should have only two stigmatic surfaces) should somehow give rise to five such surfaces. In contrast to this, in the subfamily Secamonoideae the entire style-stigma head is said to be stigmatic; a far more understandable or tenable situation.

Translator Apparatus Production

The style-stigma head performs one more extremely important function, glands on its outer surface secretes a viscous-like substance that will harden to form both the **corpuscula** and **translator-arms**. As you know from previous articles in this series, these structures (collectively called the **translator apparatus**) will attach themselves to the pollinia of adjacent anther sacs to form the **pollinarium**. In the subfamily Periplocoideae it is the style-stigma head that also secrets the substance that will form the translator spoon on which the pollen tetrads are transported.

Ovary & Ovules

The lower, swollen portion of the gynoecium (which houses the ovules) is called the ovary. The ovules, protected inside, number from one to many and are attached to a marginal placenta through which the ovary nourishes them. Interestingly the nutritive tissue supplied by the parent follicle, the **nucellus**, is **tenuinucellar** in nature (i.e. tenuous, **tenui** = thin). Ovules when they sit upon the placenta may have the **micropyle** (= pollination tunnel) facing the placenta [in such cases it is said to be **anatropous**] or the micropyle may point downwards [in such cases it is said to be **hemianatropous**] (Corner, 1976). Ovules are **unitegmic** (i.e. with one outer protective covering or **integumen**). In *Asclepias* the ovules are small (as in most asclepiads) measuring about 100 x 150µ (µ= a micrometer or **mu**, this is a millionth of a meter).

COMMENTS ON POLLINATION

Pollination in the Asclepiadaceae is **entomophilous** (by insects). These are usually, but not always, Hymenoptera (wasps & bees) and Lepidoptera (butterflies & moths) in the tribe Asclepiadeae, and Diptera (flies) in the tribe Stapelieae. We have also seen Coleoptera (beetles) and Hemiptera (bugs) visiting flowers but it is doubtful if these, in particular the Hemiptera, are pollinators; they are more probably predators or robbers. Each species is usually said to be pollinated by specific pollinators (the lock and key hypothesis) and to a degree this is probably true. Certainly it is not usual to see beetles and butterflies lying dead inside asclepiad flowers with their legs or proboscis firmly trapped in the gynostegial groove. The death vine, *Araujia sericofera* (from South America, but becoming a problematic weed in South Africa), squeezes robbing, soft bodied insects to death with its corolla; nasty! On the other hand the so called lock & key mechanism seems flexible enough to allow the production of natural hybrids at both the specific and generic levels.

Cross pollination involves the successful removal of a pollinaria from one flower to its insertion into the gynostegial chamber of another. As you can imagine, the chance of this happening seems to be fairly slim, but nonetheless it does happen often enough for this family to not only survive but flourish. In some species flowers are produced in abundance (= **floribundus**) to increase the chances of successful pollination (as in *Gomphocarpus fruticosus*), in others (such as *Asclepias affinis*)

plants live for hundreds of years so even if they only produce seed once in every five, or even ten, years the mechanism can be said to be successful. It would seem that plants such as these, that are obligated to insects for pollination, would be solely cross pollinated, but this is not the case. During the dissection of herbarium specimens we have found unremoved, *in situ* pollinia with a mass of pollen tubes germinating and moving towards the style-stigma head; suggesting that self-pollination can and does occur. Other workers have also reported this phenomenon and some species of *Stapelia* and *Hoya* are known to be cleistogamous (i.e. the flowers never open) which means these species, at least, are obligated to self-pollination. If pollination is successful, the mass transfer of pollen ensures mass seed set, so in this sense too the gamble for these plants is worth it.

CONCLUSION

When we started writing about the gynoecium we thought that we could do it in one article, after all there can't be much to be said about two carpels can there? WRONG! In fact, we found so much to say that we have decided to split the article in two, dealing with the gynoecium and pollination in this issue, and the fruit and the seed in the next. We would also like to briefly compare the asclepiad flower with the orchid flower. As a result, this series on the asclepiad flower will not finish in this volume. So we'll see you back here for a quick look at the Asclepiadaceae fruit and seed in the next issue.

ACKNOWLEDGMENTS

We would like to thank Heather Borchers for helping us with the drawings.

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The structure of the Asclepiadaceae flower

part vi: the seed and fruit

Ashley Nicholas & Himansu Baijnath,
Botany Department, University of Durban-Westville,
Private Bag X54001, Durban 4000

Introduction .

Successful pollination leads to seed and fruit development, and we will look at these structures in this issue of *PlantLife* (Figure 1). These are of course both products of the gynoecium.

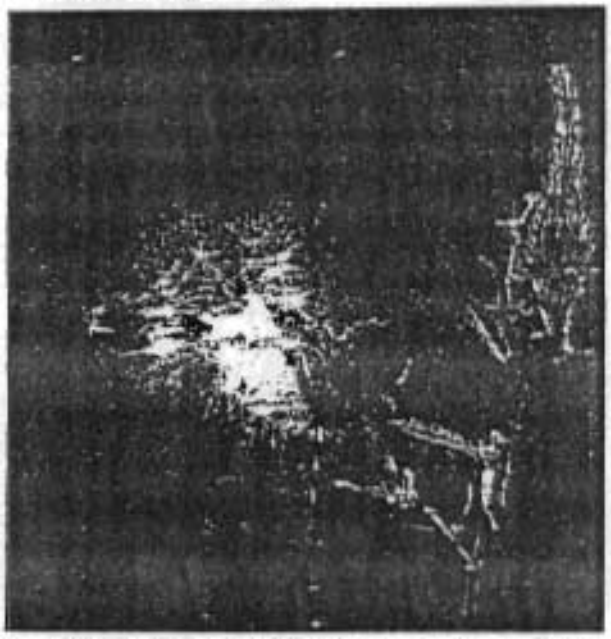

Figure 1 Photograph of fruit and coma-crowned seeds of *Schizoglossum cordifolium*.

The Fruit

Being apocarpous the gynoecium, once fertilized, will give rise to a **follicle**. This is a dry fruit that dehisces (splits) longitudinally down one margin. This type of fruit is considered to be primitive in flowering plants (Roth 1977). It may seem that this is all that can be said about such a simple fruit, but you would be surprised at just how diverse these follicles are.

Fruit number

The number of fruits can be either one or two per flower (Figure 2). If there is only one follicle produced, then this may be due to only one carpel being fertilized. In many genera the production of either one or two follicles seems to be a distinct generic character. In such cases, the production of one follicle is due to the abortion of the other, e.g. *Gomphocarpus*.

Figure 2 *Asclepias eminens* Fruit number can vary from one (A) to two (B), even in the same species. [Redrawn from Nicholas (1982)].

Fruit size

Follicles vary from 300 mm long in some species of *Marsdenia* and *Morrenia* to 400 mm in some *Schizoglossum* species.

Fruit orientation and shape

Occasionally the fruits are pendulous, as in *Araujia*, but more often than not they are more or less erect. Follicles produced in pairs can be totally erect, divergent or produced horizontally. The genus *Secamone* exhibits the full range from pendulous to erect (Figure 3). Follicles may also be straight, curved, fusiform, cylindrical, globose, or boat-shaped. Some fruits may even appear to be five-sided. *Emicocarpus* has a follicle that is extremely unusual for the family. It is indehiscent

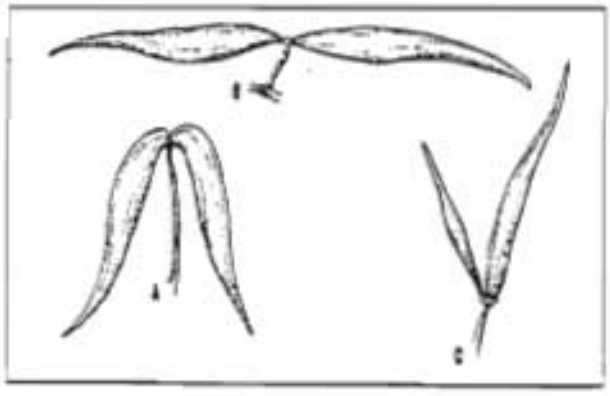

Figure 3 Types of fruit orientation as exhibited in the genus *Secamone*: A. Pendulous fruits of *S. cloiselii*, B. Horizontally produced fruits of *S. rodriguesana*, and C. Erect fruits of *S. minutifolia*. [Redrawn from Klackenberg (1992)].

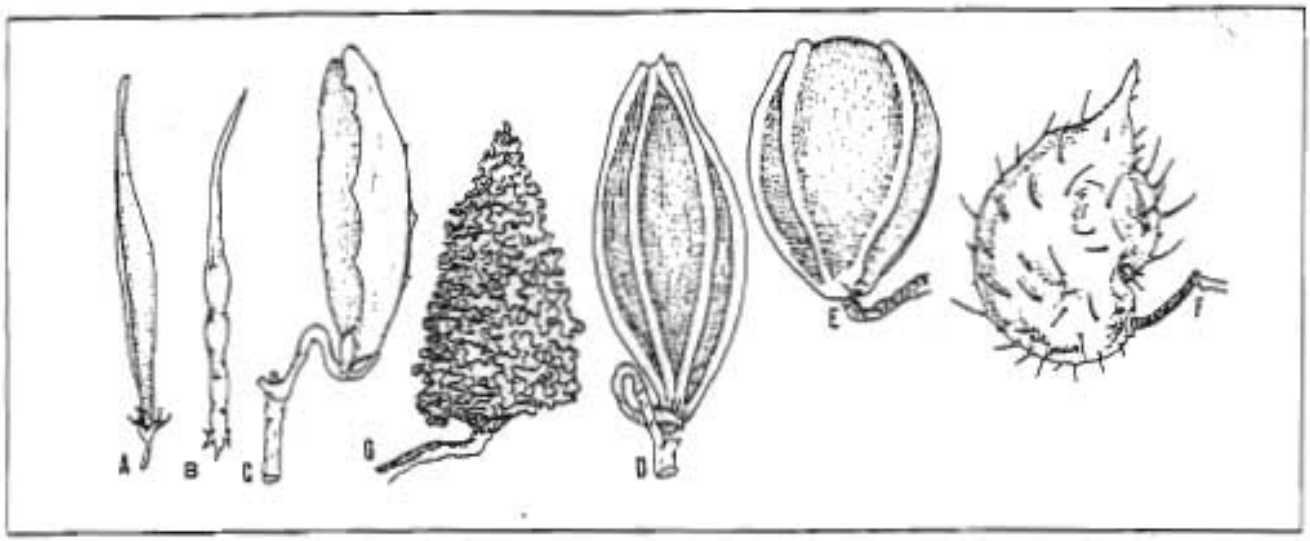

Figure 4 A range of different follicle types exhibited by the Asclepiadaceae: A. *Brachystelma tuberosum*, B. *Ceropegia meyeri*, C. *Pachycarpus vexillaris*, D. *Pachycarpus schinzianus*, E. *Pachycarpus scaber*, F. *Gomphocarpus fruticosus*, G. *Dregea abyssinica*. [(Redrawn from: A to B from Dyer (1983); C to E from Smith (1980): F. from Watt & Breyer-Brandwijk (1962); and G from White (1962)].

and three pointed. If you remember, this genus is also unusual in having a 20 piece corona in two whorls and palmately divided leaves! (Nicholas & Baijnath,1995). *Emicocarpus*, a Mozambique endemic, definitely needs more investigation.

Fruit Vestiture and Associated Characters

The follicle surface can be soft and almost membranous as in *Aspidonepsis*. In others it is a bit thicker and in yet others it can become leathery (*Kanahia*) or even subwoody (*Leptadenia*). In some species the follicles are long and narrow (*Brachystelma*), while in others they are thick (as in *Pachycarpus* - in fact, the name of this genus means thick fruit [*pachy* = thick + *carpus* = fruit]). In the genus *Gomphocarpus* the fruits are inflated with air (hence the name). The reason for this is probably to stop insects, mainly wasps, from laying their eggs in the seeds. By placing a large air space between the fruit wall and the seeds these plants try to prevent the ovipositors of insects reaching the maturing seeds. Packed with nutritive material, seeds are ideal food for insect larvae. *Riocreuxia* and some *Ceropegia* species, unlike the previously mentioned species, have thin fruit with constrictions between the seeds.

The surface of the fruit can vary from smooth, the usual state, to hairy or velvety (*Marsdenia*), to echinate (with spines, as in *Gomphocarpus* and some *Schizoglossum* species). Some have developed ridges (*Asclepias adscendens*), warts (*Prosthecidiscus*), scales (*Philibertia schreiteri*), or even wings (e.g. some *Pachycarpus*). In *Dregea* these wings have become large, dissected and irregular. Figure 4 illustrates a range of Asclepiadaceae follicle types. However, whatever the structure, shape or vestiture of the fruit, their job is to protect and nourish the developing seeds - and at the seed we will look next.

Seed: Morphology, Dispersal and germination

The number of seeds in the follicle can vary from many (as in *Xysmalobium undulatum*) to one (as in *Stigmatorhynchus* and *Emicocarpus* [again!]). In general, seeds are ovate to oblong in shape and dorso-ventrally flattened. They are also concave on the lower surface (almost folded in some species) and convex above. The margin may become papery and wing-like in a few species (*Dorystephania*), while in *Pseudibatia* this margin has become dentate. These wings can have specialized, large, air filled cells (Sylla & Albers 1989), and so help aid the seed during wind dispersal. The surface may vary from almost smooth to warty or covered with convoluted ridges.

At the narrow end of the seed (where the micropyle or pollination tunnel is located) is attached a coma of white silky hairs (Figure 5). This coma fluffs out when the seed is released from the follicle and is carried away on the wind, helping to disperse the seed. The seed detaches early and easily from the coma, making very long distant dispersal rare. Our observations in the Asclepiadaceae show that dispersal is generally only one to several meters, rarely as far as a kilometer or more. Not all seeds have the coma, as in *Emicocarpus* (yet again!) and *Madarosperma*. Good (1974) points out that the hairless seeds of *Sarcolobus* (in the subfamily Asclepiadoideae) and *Finlaysonia* (in the subfamily Periplocoideae) may be due to the fact that they live in coastal mud and on mangrove margins. These plant species "would not want" their seeds blown onto dry land where the habitat is unsuitable; they stand more chance of surviving if they fall near the parent plant where conditions are likely to be ideal.

Under the right circumstances, seeds will germinate to form new individuals, and like all dicotyledonous

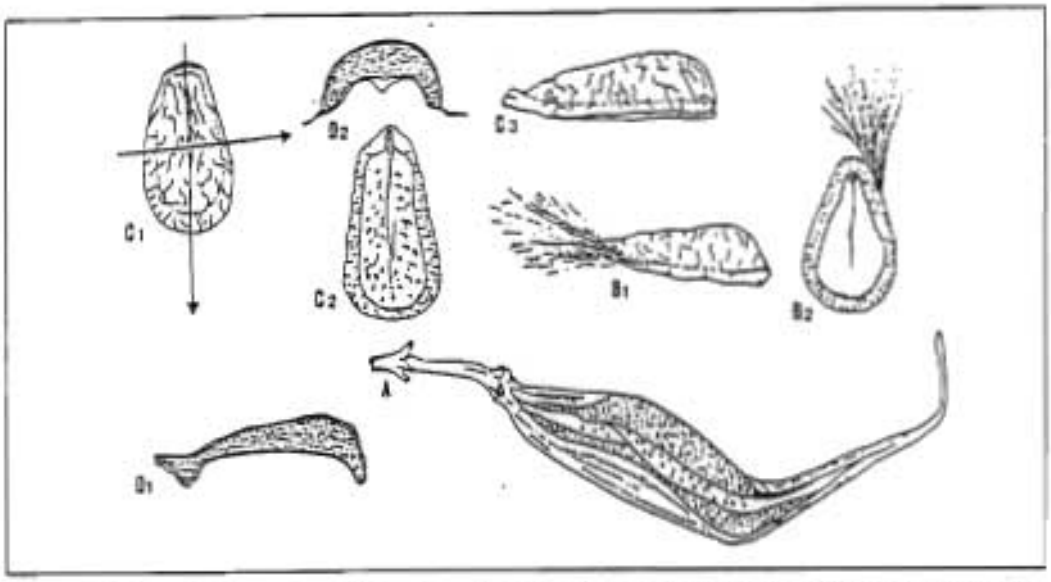

Figure 5 The seed structure of *Asclepias eminens* A. Old follicle showing longitudinal dehiscence; B1. Side view & B2. Abaxial view of seed showing coma of hairs, C1. Adaxial or upper convex surface; C2. Abaxial or lower concave surface; C3. Side view. D1. Transverse section through seed, D2. Transverse section through seed (from Nicholas 1982)

lants, the seedlings will have two cotyledons or eedling leaves. Seeds of some *Pachycarpus* species re said to need a waiting period of one year before they vill sprout. Otherwise, germination strategies in the amily have been poorly investigated, which is nfortunate as this information is vital to onservationists.

Conclusions

This ends our contribution on the structure of the sclepiadaceae flower. Although fairly comprehensive is by no means an exhaustive account of the variation ne family exhibits. In 1974 Ronald Good gave an xtensive and well written account of the sclepiadaceae flower and its pollination, and we have lied heavily on it for the last two articles. We ecommend it highly to those interested in pursuing the ubject further. In the next issue we will conclude our ontribution on the Asclepiadaceae by briefly omparing it with the most synorganized family in the onocotyledons, the Orchidaceae. The orchids are the onocot equivalent of the Asclepiads. There are many milarities, but there are also many interesting fferences between them.

cknowledgement

e would like to thank Heather Borchers for helping us ith the drawings.

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The structure of the Asclepiadaceae flower

part vii: comparison with the orchidaceae

Ashley Nicholas & Himansu Baijnath
Botany Department, University of Durban-Westville
Private Bag X54001, Durban 4000

Introduction

Convergent evolution is a phenomenon by which unrelated organisms acquire similar traits independently of each other. It results in the evolution of organisms that look similar, but which do not share their similarity as a result of having shared a common ancestor with the same trait. The wings of birds and bats are good examples of convergent evolution of structures used in flying. There are a number of evolutionary trends in the structure of flowers, such as reduction and fusion, that have occured in almost all flowering plant groups, and many similarities in flowers result from **convergent evolution.**

In response to insect pollination, two plant families, one in the dicotyledons (the Asclepiadaceae) and one in the monocotyledons (the Orchidaceae) have undergone remarkable convergent evolution. They have taken the fusion of their flower whorls to an extreme. Both families have fused the male and female whorls into one structure called the gynostegial column, and both have gathered their pollen into waxy structures called pollinia. In this way the pollen can be transported en masse by pollinators. The payback from this complex and risky strategy is that, on arrival at a receptive female stigma, massive seed set is easured. Both families entice prospective pollinators with copious nectar, and both have elaborate mechanisms for increasing the chances of pollination; the orchids often using deception and the asclepiads a maze of slipways constructed from various floral outgrowths. Interestingly, both also have terrestrial, climbing, and epiphytic forms, and both are distributed worldwide. However, the similarity between these two families ends here.

FAMILY ASCLEPIADACEAE

The Asclepiadaceae is closely related to the family **Apocynaceae** (with which it probably had a common origin) and some authorities treat them as one large family sinking the Asclepiadaceae under the Apocynaceae. An interesting feature of these plants is that they have a free ovary which develops into a follicular fruit both of which are rather primitive features!

The family consists of three subfamilies*

- Periplocoideae (with 40 genera)
- Secamonoideae (with 2 genera)
- Asclepiadoideae (with 250 genera).

In this article, we shall only discuss the structure of the Asclepiadoideae. In this subfamily the flower whorls are in parts of five (= **pentamerous**), except the gynoecium which has two parts. The petal whorl has petals overlapping like tiles with one end covered and the other exposed. It is for this reason that the Asclepiadaceae, Apocynaceae and several other families now comprising the Gentianales were previously placed in the Order Contortae. The corolla is

*The super- and infra-familial classification of this family varies quite substantially depending on the authority followed. Here we follow Schlechter, Bullock & Dyer.

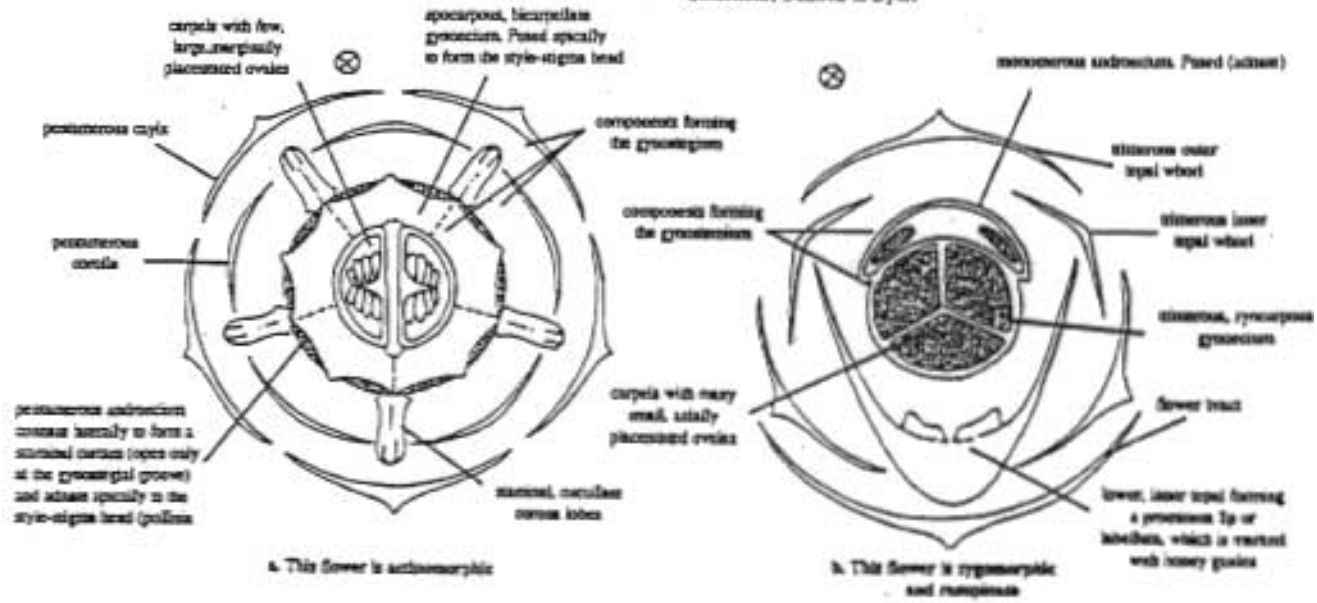

FIGURE 1. Comparative floral diagrams of: a. *Gomphocarpus physocarpus*, and; b. *Cymbidium* species.

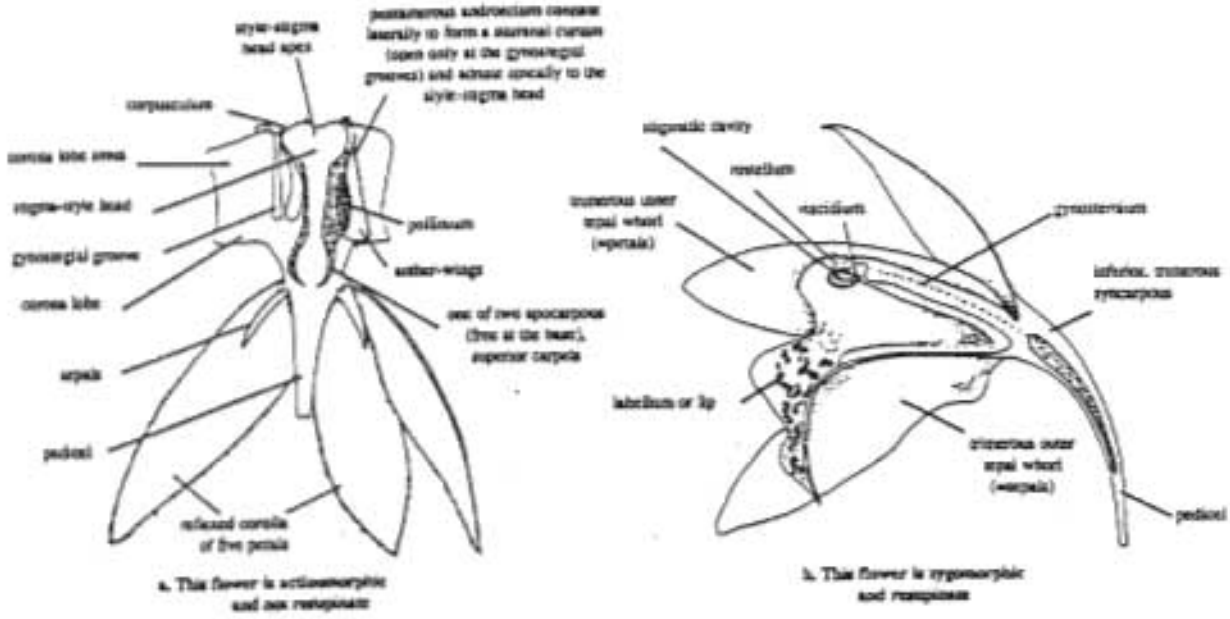

FIGURE 2. Comparative half-flower drawings of: a. *Gomphocarpus physocarpus*, and; b. *Cymbidium* species.

often **sympetalous** (petals fused to each other), but if the petals free then the corolla is usually reflexed. The androecium (= male whorl) is connate or **synandrous** and forms a **staminal curtain** (often also called the **staminal column**) which surrounds the female whorl and is attached to it apically at the **style–stigma head**. The androecium and gynoecium thus form a single structure which is known as the **gynostegium**. There are usually complex outgrowths from the staminal or male whorl, called **coronas**; these may be free (forming lobes) or joined together, and may also be associated with basal nectaries. The stamens often bear terminal membranes or hairs to prevent insects from tearing them away from the stylestigma head during pollination. The anthers have 2 sporangia and 2 chambers due to the abortion of one theca in each pair. The remaining thecae are separated and protected by an expanded connective which becomes hardened along its outer margins; these being known as **anther–wings**. The anther–wings of adjacent anthers press together, forming a slit known as the **gynostegial groove**. The pollen from each of the remaining anther theca coalesces into a single, waxy mass called a **pollinium**. The **pollinia**, plural of pollinium, *from adjacent anther thecae* are joined together by **translator–arms** which are attached to a single, common, hard, clip–like body called the **corpusculum**. The entire apparatus is known as a **pollinarium**. The corpusculum and translator–arms, collectively called the translator apparatus, are formed from secretions produced by the anther and style–stigma head. The corpusculum is attached to the style–stigma head and sits at the top opening of the gynostegial groove.

The *gynoecium is superior* and is made of two free carpels with style at first distinct, but later becoming fused apically into a common, thickened style–stigma head. The stigmatic surfaces occur as patches which sit on the style–stigma head just below each gynostegial groove. The staminal or androecial curtain is attached to the rim of the style–stigma head at spots alternating with these stigmatic patches.

During pollination the corona and associated structures guide the insect's leg (or proboscis) into the bottom of the gynostegial groove where it gets caught. To get it out the insect has no choice but to draw the leg up the groove and past the corpusculum, which clips on as it does so. As the insect flies away the entire pollinarium is pulled out of the gynostegium and is carried off. On reaching another flower of the same species the insect's leg again gets caught, and as it attempts to pull it through the gynostegial groove, one of the pollinia will be dragged up into the groove where it will become lodged and germinate. When the pollen tubes germinate they move in mass towards the carpels (Figures 1, 2 & 3).

FAMILY ORCHIDACEAE

The Orchidaceae requires a symbiotic association with fungi to germinate and survive. In epiphytic species the aerial roots become modified, the epidermis proliferating into a spongy, water absorbing layer called the **velamen**. The stem bases of epiphytic orchids become thickened to form pseudobulbs, while terrestrial species have rhizomes, tubers or corms. The flowers are **resupinate** i.e., the pedicel twists during flower development so that the upper side appears to be the lower side and vice versa.

The Orchidaceae is divided into three subfamilies:
Apostasioideae (with 2 genera),
Cypripedioideae (with 4 genera), and;
Orchidioideae (by far the largest with 754 genera).

In this article, we shall only discuss the structure of the Orchidioideae. In this subfamily the perianth is usually petaloid and in 2 whorls, both of which have 3 parts. The tepals of the outer whorl (sepals) are either all the same or the upper one is different from the rest. The tepals of the inner whorl (petals) have the lower lobe or tepal very noticeably different from the other two and it may often form

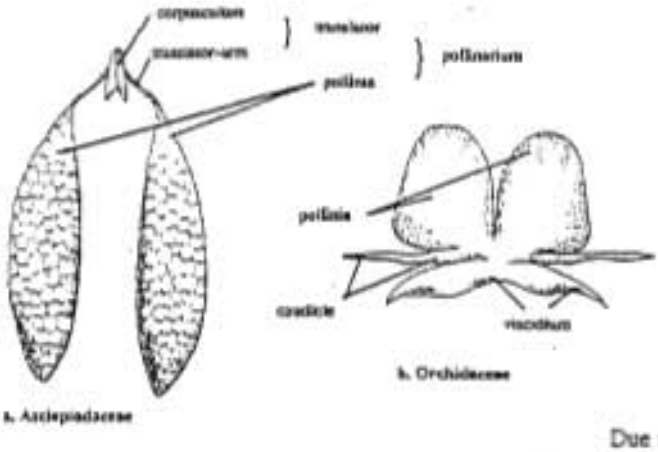

FIGURE 3. Comparing the pollinaria of: a. *Gomphocarpus physocarpus*, and b. *Cymbidium* species.

a large lip-like structure called the **labellum**. The lateral petals are usually similar to the sepals. There may be nectaries of various sorts on all the whorls, but the **petaliferous nectaries** are often quite noticeable and may form long, hollow spurs that project backwards and downwards from the flower. There is one stamen in the Orchidioideae. This stamen is found on the upper surface opposite the labellum and attached to the style, forming a column or **gynostemium**. The anthers have 4 sporangia and 2 chambers — the two thecae often being widely separated. Pollen grains have 1 pore, sometimes 2 pores, and usually arranged into pollinia. There are from 1 to 6 pollinia in each theca (sometimes subdivided into smaller groups called **massulae**). The one end of the pollinia is extended into a **caudicle**. The *gynoecium is inferior* and composed of 3 fused carpels (i.e. its is syncarpous or fused as opposed to apocarpous or free). The gynostemium is column–like and terminated by the solitary anther and 3–lobed stigma. One of these stigmatic lobes enlarges to form an expansion that separates the single anther from the other two stigmatic lobes which produces a sticky pad onto which the caudicles of the pollinia are attached. The base of the gynostemium produces a foot onto which the labellum is joined.

During pollination the orchid flower attaches the sticky pad to the pollinating insect (usually, but not always, its head), and as it flies away it pulls the pollinarium with it. When the pollinating insect reaches another orchid (usually of the same species - pollinators are normally species-specific) the pollinator is then tricked by the flower into placing the pollinia onto the receptive stigmatic surface of the gynostemium. Here it will germinate, the pollen tubes moving en masse to fertilize the numerous and very tiny ovules. The resulting embryos are unusual because they do not have stored food, which is why they need fungi to help them germinate and survive. Seeds are numerous (1000 to several million) and tiny.

Orchids are of horticultural interest and of importance to the cut–flower industry, and are also the source of the food flavouring vanilla essence. They have a distinct advantage over the asclepiads because their flowers are irregular; bilaterally symmetrical. This has allowed the Orchidaceae flower to become larger and more complicated than the regular, symmetrical Asclepiadaceae flower. Bilateral symmetry has enabled the orchids to evolve elaborate spurs and pouches and to even mimic the insects that pollinate them (Figures 1, 2 & 3).

Discussion

The asclepiads and the orchids are the gamblers and Russian roulette players of the angiosperms. Pollination has become such a complicated affair with them that it is often prone to failure.

Due to the finely tuned selective pressures of co–evolution, it almost seems as though the two families, plus their insect pollinators, are propelling themselves at quite a heady rate through evolutionary time. Who knows what bizarre structures and behaviour this head long rush could have ended in, had not man started (through massive habitat destruction) to destroy the future of both of these groups. Both families are now so highly specialized that many of their species are unable to adapt to the rapidly changing environments with which they are faced; especially to the loss of their specific pollinators which have been killed off by the indiscriminate use of pesticides. In this sense, at least, they may have become evolutionary dead ends for the angiosperms. Also, in recent times, because both families have become highly prized by plant collectors and breeders, they have fallen prey to unscrupulous plant hunters out to exploit them for money. Discussion of these two fascinating families could fill a book but we will stop here.

Conclusion

That concludes our series on the Asclepiadaceae flower. We have realized that at times we have made things a bit technical for a journal that caters for amateur botanists. However, we felt that it was important to introduce you to a range of terminology that not only applies specifically to the Asclepiadaceae but which can also be applied to all flowering plants. By doing this we hope you have gained some insight into the world professional botanists live and work in. Besides being educated, we also hope you have enjoyed our contribution.

Acknowledgment

We would like to thank Heather Borchers for helping us with the drawings of the half flowers and pollinaria.

Ashley Nicholas is a plant systematics lecturer and expert in Asclepiadaceae in the Botany Department at the University of Durban-Westville.

Hlmanshu Baijnath is Professor in the Botany Department and Curator of the Ward Herbarium at the University of Durban-Westville. He is a specialist in petaloid monocots.

CHAPTER 3

CLASSIFICATION AND PHYLOGENY OF THE GENTIANALES

INTRODUCTION

It was felt that an insight into the evolutionary origins of the Asclepiadaceae would give a better understanding of the patterns exhibited by characters within the family and that this would lead to a better classification for the subtribe Asclepiadinae; one of the objectives of this thesis. As the origins of the Asclepiadaceae are tied into those of the order to which it belongs, the initial research for this dissertation centered around the classification and phylogeny of the Gentianales. The paper that follows this introduction is the findings of that research.

Although it takes the form of a taxonomic treatment, this published paper also summarises the character patterns within the order. From these patterns, there can be little doubt that the Asclepiadaceae and Apocynaceae form a close family pair (Judd *et al.*, 1994), possibly best treated as one family or placed in its own superorder; see introductory chapter. Their next nearest ally is the Rubiaceae. Within the Gentianales, the Loganiaceae forms the most taxonomically complex family and the one that shows a predominance of primitive characters.

In this paper, we suggest that the Gentianales probably had its origin from a common ancestor with the superorder Cornanae *sensu* Takhtajan (1987). In particular, many common characters seem to place it nearest the Hydrangeales and Cornales. Subsequently, I have begun to believe that the Gentianales may rather have had a common origin with the superorder Rosanae *sensu* Takhtajan, in particular the Saxifragales. The origin of the Gentianalian gynoecium, especially the prevalent bicarpellate condition, would fit here just as well. Colleters are also more common in this superorder than in the Cornanae and have been recorded in the Rhizophoraceae, Rosaceae and Saxifragaceae (Gonzáles, 1998). Within the Gentianales they are found in the Saccifoliaceae, Loganiaceae, Rubiaceae and Apocynaceae (including Asclepiadaceae); in fact they are only absent in the Gentianaceae. Colleters are unusual

structure that contain proteins or lipophilic substances, carbohydrates and mucilages. They are believed to protect the very young leaves or their stipules. In the Asclepiadoideae, colleters are common on the interpetiolar scar, in the leaf axils and at the base of the calyx, where they are sometimes known as squamellae. Their presence at the base of the sepals support the evolution of these structures from leaves (euanthial theory of flower origin, see Doyle & Donoghue[1993] and Doyle [1994]) rather than from modified branches (pseudanthial theory of flower origin, see Taylor & Hickey [1996a & 1996b]). Interestingly, this conflicts with structural data from *Triglogcan* L. (Juncaginaceae) which favours the pseudanthial theory.

The fact that both the Rosanae and Cornanae show numerous links to the Gentianales is not surprising given that both probably arose from a common ancestor. Possibly the Gentianales had an origin from somewhere near or within these two superorders as they were differentiating.

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Please note the following errata in the paper that follows:

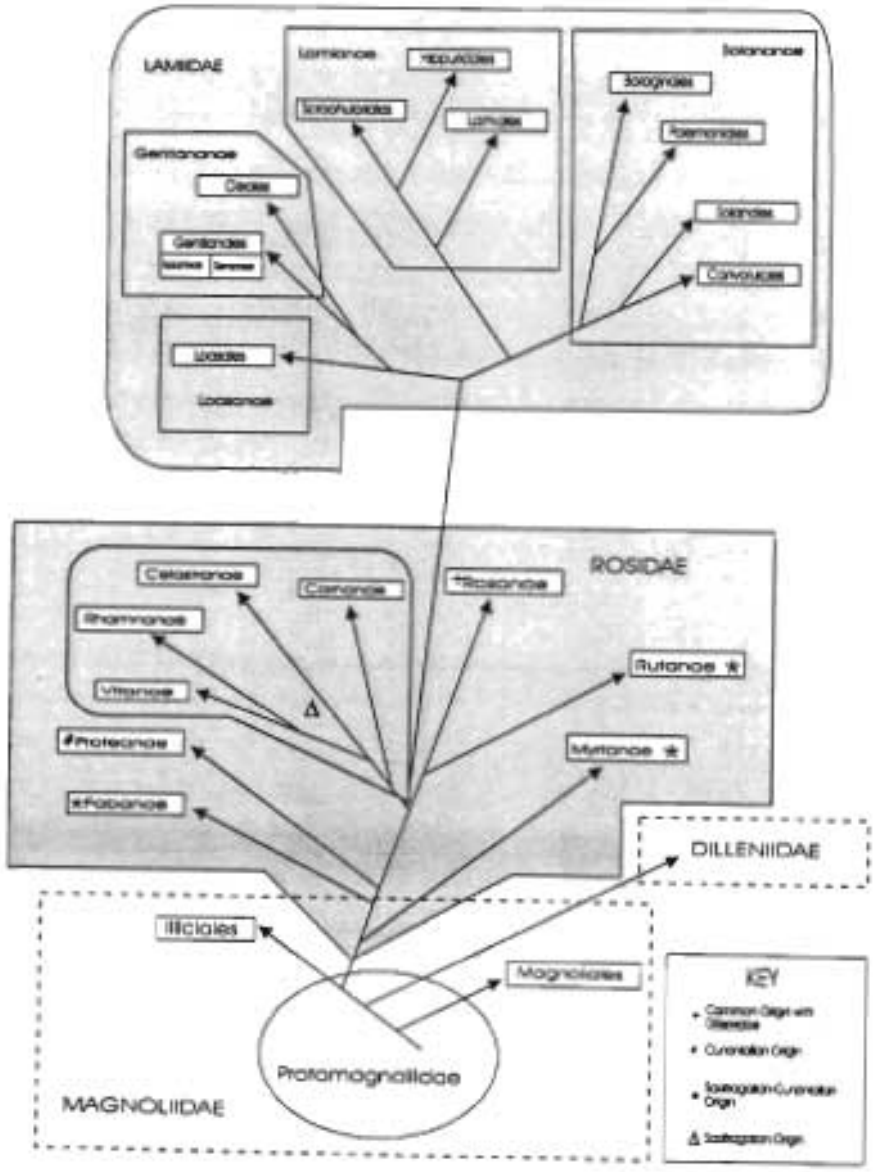
Figure 1 goes with the caption of figure 5

Figure 2 goes with the caption of figure 4

Figure 3 is right

Figure 4 goes with the caption of figure 2

Figure 5 goes with the caption of figure 1



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A Consensus Classification for the Order Gentianales with Additional Details on the Suborder Apocynineae

A. NICHOLAS AND H. BAIJNATH

Botany Department, University of Durban-Westville
Private Bag X54001, Durban 4000
South Africa

I. Abstract

The Gentianales as circumscribed by Benson, Cronquist, Dahlgren, Goldberg, Heywood et al., Melchior, Stebbins, Takhtajan, and Thorne is investigated. From these a consensus classification (not in the cladistic sense) or classificatory model for the order is proposed. This classification is discussed, as are the relationships of the taxa within it. Excluded taxa are also discussed. In particular, the Apocynineae is examined in detail and it is pointed out that for this suborder the present consensus classification, at the family level, is congruous only if the taxa involved are monophyletic. Data are then supplied to show that, as yet, neither monophyly nor paraphyly can be proved conclusively for the taxa of the Apocynineae.

Résumé

Cet article examine l'ordre des Gentianales tel qu'il se décrit chez Benson, Cronquist, Dahlgren, Goldberg, Heywood et al., Melchior, Stebbins, Takhtajan et Thorne. A partir de ceci un schéma classificatoire est proposé pour l'ordre. Cette classification convenue est discutée, ainsi que les relations des taxa y figurant. Les taxa exclus sont également discutés. L'ordre des Apocynineae subit un examen particulier et il est avancé que pour ce sous-ordre la classification convenue actuelle, au niveau de la famille, n'est convenable que lorsque les taxa en question relévent d'un seul phylum. Finalement les données sont appliquées pour démontrer qu'il n'existe jusqu'à présent aucune preuve définitive quant à la monophylie ou la paraphylie des taxa de l'ordre des Apocynineae.

II. Introduction

A comparison of the Gentianales was undertaken using the proposed classifications of Benson (1979), Cronquist (1988), Dahlgren (1983), Goldberg (1986), Heywood (1978b), Melchior (1964), Stebbins (1974), Takhtajan (1983), and Thorne (1992) (Table I). These classifications were chosen because the authors involved used multifarious data sources and because they encompassed the whole of the dicotyledons. A consensus classification was then established based on how these authorities interpreted the data available for the order. Consensus is not used here in the cladistic sense (see Barrett et al., 1991); in fact, the reverse may be true, as the authorities chosen here have all used the *principle of total evidence*.

Only families with 50% to 100% consensus for inclusion are considered here to constitute the order Gentianales. It is hoped that this classificatory model of the Gentianales will be helpful to those teaching systematics at colleges and universities. Certainly it forms a useful base for students to build on or change as their knowledge and hands-on experience of the taxa involved grows. It may also prove useful to

Table I

A comparison of the family composition of the Gentianales, with approximate figures for number of genera and species in each family as given by Airy Shaw, 1985 and Brummitt, 1992. The Carlemanniaceae has apparently only been included in the Gentianales by Takhtajan (1987; see Brummitt, 1992) and is not included in this table.

	Melchior 1964	Stebbins 1974	Heywood 1978b	Benson 1979	Takhtajan 1983	Dahlgren 1983	Goldberg 1986	Cronquist 1988	Thorne 1992
Family (approximate n° of genera/species per family)									
Gentianaceae (75/1000)†	✓	✓	✓	✓	✓	✓	✓	✓	✓
Saccifoliaceae (1/1)†	—	—	—	—	✗	✓	—	✓	✓
Menyanthaceae (5/40)	✓	✗	✗	✗	✓	✓	✓	✗	✗
Loganiaceae (6/500)†	✓	✓	✓	✓	✓	✓	✓	✓	✓
Buddlejaceae (10/160)	✗	✗	✗	✗	✗	✗	✗	✗	✗
Desfontainiaceae (1/1–5)*	✓	—	—	—	✗	✓	✗	✗	✓
Plocospermataceae (1/3)*	—	—	—	—	✗	—	✓	✗	✗
Retziaceae (1/1)	✗	—	—	—	✗	✗	—	✗	✗
Rubiaceae (600/7500)†	✓	✗	✗	✗	✓	✓	✓	✗	✓
Theligonaceae (1/3)*	✗	✗	✗	✗	✓	✓	✗	✗	✗
Dialypetalanthaceae (1/1)	✗	✗	—	—	✓	✓	✗	✗	—
Apocynaceae (170/1800)†	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asclepiadaceae (250/2000)†‡	✓	✗	✓	✓	✓	✓	✓	✓	✗
Periplocaceae (45/200)*	✗	—	✗	✗	✗	—	✗	✗	✗
Oleaceae (25/600)	✗	✓	✓	✓	✗	✗	✗	✗	✗
Salvadoraceae (3/12)	✗	✗	✗	✗	✗	✗	✗	✗	✗
Convolvulaceae (55/1750)	✗	✗	✗	✗	✗	✗	✓	✗	✗
Cuscutaceae (1/170)	✗	✗	✗	✗	✗	✗	✓	✗	✗
Columelliaceae (1/4)	✗	✗	✗	✗	✗	✗	✓	✗	✗

‡Endress (1990) cites as many as 2900 species for this family

*, Inclusion in other Gentianalian families

—, Family not mentioned by authority

†, 50 to 100% consensus that these families constitute the Gentianales

workers employed in routine herbarium curation, plant identification, and the compilation of systematic lists of various kinds. Becker (1973) and Swift (1974) completed similar exercises when they compared six and eight systems of angiosperm classification, respectively, some unfortunately pre-dating the modern phylogenetic paradigms that dominate present macrosystematics. The Gentianalian model given here differs from Swift's in that 1960 has been used as a cut-off date for classifications used in the consensus. This has been done because these post-1960 macrosystematic classifications have used the vast store of multifarious data (including chemical) currently available. They are therefore a synthesis of information on a grand scale. However, older classifications should not be ignored on this account, and, although not forming part of the consensus, they are also briefly mentioned to give a more-or-less complete picture of the order.

There may be a major criticism concerning the consensus model presented in this paper, regarding the nine classifications that were chosen to obtain the necessary statistics. The classifications of Emberger (1960), Hutchinson (1969), Rouleau (1981), and Young and Seigler (1981) have not been used. If included they would alter the picture only slightly; in fact, the only major change would be the addition of the Menyanthaceae to the Gentianales by a consensus majority of 61%. However, as will be pointed out later, the available data does not support this family's inclusion. The other families would remain within the order with the following consensus figures (consensus figures from the nine chosen classifications are given in parentheses for comparison): Gentianaceae, 100% (100%); Loganiaceae, 58% (100%); Apocynaceae, 92% (100%); Asclepiadaceae, 77% (78%); Rubiaceae, 54% (56%); and Saccifoliaceae, 75% (75%).

Heywood (1974) makes a plea for establishing priorities in systematic research; the consensus model given here highlights families that should be targeted as priorities for detailed investigation using modern methods, namely, the Columelliaceae, Dialypetalanthaceae, Menyanthaceae, Oleaceae, and Salvadoraceae. Data accumulation for these taxa may uncover interesting evolutionary pathways, so improving present classifications and making them more predictive (Stuessy, 1993) and also more useful as tools for understanding and managing the earth's biodiversity. The predictivity of classifications is already important for locating chemicals, particularly those of medicinal or economic importance. Such predictivity may also become more important as a means of locating genes for use in the growing field of genetic engineering. *Data accumulation must be done while enough of the species making up these families are still extant.* These particular plant families may represent the last living pieces in an evolutionary jigsaw puzzle in which many of the pieces were already lost long before the development of taxonomy. We cannot afford further loss of diversity and its associated data, because even present gaps in our information make untestable the development of hypotheses concerning present relationships and past important phylogenetic trends (which depended on prehistoric modes of selection and speciation). We cannot base all our hopes on finding the fossil evidence necessary to complete this task.

Not included in the data for this consensus model, but nevertheless of historical importance, is the classification of Hutchinson (1969), who divided the dicotyledons into two major groups: the Lignosae (fundamentally woody plants) and the Herbaceae (fundamentally herbaceous plants). In the Lignosae could be found the Rubiales (consisting of the Dialypetalanthaceae and Rubiaceae), the Apocynales (consisting of the Apocynaceae, Asclepiadaceae, Periplocaceae, and Plocospermataceae), and the Loganiales (consisting of the Antoniaceae, Buddlejaceae, Loganiaceae, Oleaceae, Potaliaceae, Spigeliaceae, and Strychnaceae). The Gentianales (consisting of the Gentianaceae and Menyanthaceae) occur in Hutchinson's Herbaceae. Because of the rather artificial division into herbaceous and woody plants and the very narrow ordinal circumscriptions, it is difficult to include Hutchinson's otherwise historical classification in the present consensus model. However, where applicable, Hutchinson's ideas and concepts are discussed. To some degree, Benson's (1979) classification of the angiosperms into Thalamiflorae, Corolliflorae, Calyciflorae, and Ovariflorae is slightly artificial as well, but not so much so that it needed to be omitted for comparison in this study.

Unfortunately, Takhtajan's (1987) latest work is presently unavailable to the authors

and it has not been possible to incorporate it into this consensus. As outlined in Brummitt (1992), Takhtajan's 1987 system differs from his 1983 system in recognizing the Saccifoliaceae, Desfontainiaceae, Plocospermataceae, and Spigeliaceae as distinct families. A newly included family is the Carlemanniaceae, usually included by consensus in the Caprifoliaceae. No families were reduced to synonymy or transferred out of the Gentianales as he defined it in 1983. Interestingly, Takhtajan (1987) seemed to restrict the circumscription of the Asteridae to the Campanulales and allies and the Asterales. The bulk of the orders that used to fall in the Asteridae now fall under the subclass Lamiidae, which includes the superorder Gentiananae—composed of the orders Gentianales and Oleales (this later being monofamilial). The Salvadoraceae can still be found in the Celastrales, the Columelliaceae in the Hydrangeales (suborder Escalloniineae), the Convolvulaceae and Cuscutaceae in the Convolvulales, and, finally, the Buddlejaceae and Retziaceae he placed in the Scrophulariales.The authors have also not had access to Young and Seigler (1981) and have used an account of their system given by Goldberg (1986). Brummitt (1992) also gives an account of Young's system. Here the Gentianales is composed of the Loganiaceae, Buddlejaceae, Rubiaceae (including Theligonaceae), Apocynaceae, Asclepiadaceae, Gentianaceae, and Menyanthaceae. The Columelliaceae may be found in the Hydrangeales and the Salvadoraceae, the Oleaceae (and Barbeyaceae) in the Oleales, and the Convolvulaceae (presumably including the Cuscutaceae) in the Solanales. No mention seems to be made of the Dialypetalanthaceae, Retziaceae, or Saccifoliaceae.

It is not within the scope of this paper to give detailed information on the morphology, anatomy, chemistry, etc., for each taxon involved, although the literature cited contains much of this data or cites literature that does. However, data and information considered by these authors to be significant are highlighted in the text of this paper.

Lastly, a computational analysis by Young and Watson (1970) highlights the taxonomic soundness of the order Gentianales. Their analysis, however, included only the families Apocynaceae, Asclepiadaceae, Gentianaceae, Periplocaceae, and Rubiaceae.

III. Historical Account of the Gentianales

Classifications, including those of higher taxa, will continue to change as our knowledge of these groups and their relationships changes. Based on the accumulation of additional data and the way in which the data are interpreted, taxa are added, shuffled, or deleted. Classifications are therefore largely eclectic in nature and we seem to proceed toward a clearer picture of the plant world, past and present, by successive approximations toward a (probably unattainable) state of total knowledge. Important also is that with each approximation the predictivity of the classificatory model increases, thus increasing the value of the classification to humankind. As a result, present-day concepts can be clearly understood only in the light of their own evolution. To obtain a useful taxonomic picture, workers must therefore undergo a certain amount of mental or intellectual recapitulation of the pivotal taxonomic events (taxonomic interpretations and decisions) and historic scientific paradigms that lead to the moulding of modern classifications.

The historical, angiosperm-wide classifications of the 1800s had a great influence on present-day concepts within the Gentianales. In particular, two historical classifi-

cations are important: Bentham and Hooker's *Genera Plantarum* (1862–1883) and various authors in Engler and Prantl's *Die Natürlichen Pflanzenfamilien* (1887–1915). These two classifications are still used as the basic phylogenetic systems on which most major herbaria are structurally based and on which their continuing daily operation depends. The system of Bentham and Hooker continues to be followed in Britain and much of the British Commonwealth; that of Engler and Prantl (as modified by de Dalla Torre & Harms, 1900–1907) is still used in much of continental Europe and countries historically associated with it. Lastly, mention should be made of the influential American botanist Asa Gray, who took the natural classificatory systems of Europe and adapted them for use in North America (Gray, 1878). Gray's system influenced the arrangement of specimens in many early United States herbaria and continues to do so (Fernald, 1950). As herbaria are essentially large phylogenetic models (which we use for understanding, studying, and managing the phytodiversity of the world), most taxonomists have grown up using one of these historical classifications (or a modification) as a framework on which to work and build. As a result, we are all, to some extent, prisoners of our past learning and experience. In fact, Walters (1961) goes as far as suggesting that the present stability we see in many angiosperm families is due to taxonomists' unwillingness to change them, and family boundaries must therefore remain suspect. Whether this statement is true or not remains part of the ongoing systematic debate.

It is therefore important to discuss briefly the taxonomic and nomenclatural evolution of the Gentianales.

A. THE BEGINNINGS OF THE GENTIANALES

Historically it was Bartling (1830) who first brought together the families traditionally associated with the Gentianales and to which he applied the name Contortae. However, it was Lindley (1833) to whom the formal description of the order is attributed, he being the first author to consistently use the suffix *-ales* to denote the rank of order. Later, Lindley, having placed the Apocynaceae and Asclepiadaceae in the Gentianales, proceeded to place them apart (Lindley, 1845), the Apocynaceae being in the Gentianales and the Asclepiadaceae in the Solanales. In his 1867 account, Lindley gives a small nearest-neighbour diagram after each family description/discussion. If these diagrams are fitted together, a rather interesting picture emerges that not only tends to place the Gentianales together but allies them to the Cornales (Fig. 1). This concurs, to some extent, with modern evidence and ideas. Melchior (1964) was the first authority to include the Rubiaceae in the Gentianales, although this idea gained wide acceptance only in the classifications of the 1980s.

B. BENTHAM AND HOOKER

In their *Genera Plantarum* (1862–1883), Bentham and Hooker defined the Gentianales as containing the Apocynaceae, Asclepiadaceae, Gentianaceae, Loganiaceae, Oleaceae, and Salvadoraceae. The Asclepiadaceae was considered to include the Periplocaceae as the subfamily Periplocoideae. The Loganiaceae included the Antonieae, Buddlejeae, Desfontainieae, Potalieae, Spigelieae, and Strychneae under the tribe Euloganieae, while the Plocospermateae was included under the tribe Gelsemieae. The Gentianaceae included the Menyanthaceae as the tribe Menyantheae.

Fig. 1. Extract from Lindley's (1867) nearest-neighbour analysis. Solid lines = accepted taxa clustered according to ICBN hierarchies; dashed lines = relationships not expressed by nomenclature.

Excluded families: The Rubiaceae was placed in the order Rubiales under the major division Inferae (due to its inferior ovary). The Convolvulaceae (including Cuscutaceae as the tribe Cuscuteae) was included in the Polemoniales. The genus *Retzia* (≡monotypic Retziaceae) was placed in the Solanaceae (which was also included in the Polemoniales). The Columelliaceae fell under the Personales (along with the Scrophulariaceae). The Theligonaceae was placed as a tribe, the Theligoneae, under the Urticaceae. The Dialypetalanthaceae had not yet been discovered.

C. ENGLER AND PRANTL

Various authors in Engler and Prantl's *Die Natürlichen Pflanzenfamilien* (1887–1915) dealt with the families of the Gentianales as follows. The Series Contortae is considered equivalent to Bentham and Hooker's Gentianales. Series Contortae was divided into two subseries. The first of these, the Oleineae, contained the families Oleaceae and Salvadoraceae (Knoblauch, 1892). The second subseries, the Gentianineae, contained the Loganiaceae, Gentianaceae, Apocynaceae, and Asclepiadaceae. The Loganiaceae included the tribes Antonieae, Fragraeae (which in turn included the Potalieae), Loganieae, Spigelieae, and Strychneae under the subfamily Loganioideae and the Buddlejaceae under the subfamily Buddlejoideae, while the monotypic Desfontainieae and Plocospermateae were placed at the end of the family with a mention of their uncertain taxonomic position (Solereder, 1892). The Gentianaceae included the Menyanthaceae as the subfamily Menyanthoideae (Gilg, 1895). The Asclepiadaceae included the subfamily Periplocoideae (Schumann, 1895).

Excluded Families: The Rubiaceae (Schumann, 1891) was placed in the Rubiales under the Sympetalae. The Convolvulaceae (including the Cuscutaceae as the subfamily Cuscutoideae) (Peter, 1891) was placed under the series Tubiflorae in the subseries Convolvulineae. *Retzia* was included under the family Solanaceae (Wettstein, 1891) but with comments on its close relationship to the Loganiaceae. The Theligonaceae was a synonym under the family Cynocrambaceae (Poulsen, 1893). The Dialypetalanthaceae had not yet been discovered. Reference should also be made here to Engler's *Syllabus der Pflanzenfamilien* (the 1912 edition assisted by Gilg and the 1936 edition co-authored by Diels).

IV. Comments on Classification above the Level of Order

Interestingly, the beginnings of the concept of the subclass Asteridae (to which the Gentianales belongs) can be seen as early as Jussieu (1789) and his Class VIII-*Monopetalae, corolla hypogyna* and de Candolle's (1813) Corolliflorae. In fact, the Corolliflorae used by Benson (1979) has its beginnings in the classification of de Candolle (1813–1819). Bartling (1830) was the first to use the term Contortae, this name being used for the last time by Wettstein in 1935, while the category Sympetalae, first used by Engler and Prantl (1887–1915) in 1897, was used right up until 1964 by Melchior. The use of the term Asteridae to denote this particular subclass seems to have first been used by Takhtajan in 1964. Cronquist (1988), Heywood (1978b), and Takhtajan (1983) have more or less retained this (± sympetalous) circumscription of the Asteridae, while Dahlgren (1983), Takhtajan (1987; see Brummitt, 1992), and Thorne (1992) have abandoned it in favour of a number of separately and more narrowly defined subclasses. Takhtajan (1987) and Thorne (1992) have also tended to make more use of the superordinal and subordinal ranks than any of their predeces-

sors, thus making suggested relationships within and between groups more apparent to users of macrosystematic classifications; see Wagenitz (1977) for further discussion of the subclass Asteridae.

In 1977, Dahlgren used the suffix *-anae* to denote these macrotaxa but subsequently changed this to *-iflorae* (Dahlgren, 1983). However, the suffix *-iflorae* is of limited value, in that it can only be applied to angiosperms, and is thus best avoided. The use of this suffix by R. Dahlgren has been changed to *-anae* by G. Dahlgren (1989). Thorne (1992) has also adjusted his system, and his subclasses now end in the suffix *-anae*.

Many of the groupings of Cronquist, Dahlgren, Takhtajan, and Thorne are similarly circumscribed, indicating a growing consensus, probably due to the holistic, systematic synthesis of all available data by these different workers. Unfortunately, much of the similarity of these systems is masked by inconsistently used basionyms for the macrotaxa. To establish clarity and order for these macrotaxa, urgent attention should be given by phylogenists to establish some sort of taxonomic priority, complete with basionyms, as is used for microtaxa. Cronquist's 1981 classification is nomenclaturally superior to its contemporaries, and it is therefore not surprising that it is now linked to the ideas, specimens, and literature of a continental flora (Kanis, 1981). As a result of this, Cronquist's (1981) choice of basionym has been followed in this work if two or more names compete for priority after 1753. Thus the name Gentianales (published 1833) has been accepted above the name Loganiales (also published 1833). Having said this, the classifications of Takhtajan (1987) and Thorne (1992) are believed by these authors to express relationships better than those of their contemporaries, although the merits of other contemporary classifications, particularly those of Cronquist (1981) and Dahlgren (1983), should not be ignored. Unfortunately, Thorne's (1992) work lacks synonyms, authorities, and literature citations; there is also a hesitancy on the part of modern taxonomists to accept this worker's often large family circumscriptions. Many of Thorne's subfamilies tend to correspond to the families of most other contemporary classifications, and his system may be viewed as a lumper's classification. At the other end of the spectrum, the classification of Hutchinson (1969), with its many small families, can be seen as a splitter's classification. In this paper the Asteridae is used in the sense of Cronquist (1988).

V. Phylogenetic Considerations

Besides being largely speculative, phylogenetic concepts are seriously hampered by nomenclature. Names of taxa carry concepts concerning the world as we symbolize it in speech. It is the problem of Popper's three worlds: the physical, the mental, and the symbolic as typified by speech (see discussion by Loevtrup, 1987). Whereas names and their symbology are static (Popper's third world) the taxa themselves have changed and are changing, often quite substantially, with geological time (Popper's first world). To apply present-day names such as the Loganiaceae to its early ancestors is therefore quite inappropriate. At the time of its emergence, this taxon (which may, using present paradigms, have been considered only a tribe or even genus of some extinct family) was a very different entity from the one we see today. The use of modern names to symbolize prehistoric taxa is fraught with danger. However, in the absence of a complete fossil record we are left with no choice but to use present-day concepts when we talk about these taxa. Where possible, we have used the prefix

proto- to denote that these taxa would have been circumscribed very differently from their present-day progeny. Readers must bear this in mind during the following discussion.

Multifarious data suggest that the Asteridae may have arisen from what was an amorphous Cornales–Saxifragales–Rosales-like* complex of related taxa [*Cornales of Dahlgren (1983) or Rosanae–Cornanae of Thorne (1992)]. The Escalloniaceae, a present-day taxon of this complex, is of interest, in particular the genus *Tetracarpaea*, which has an apocarpous gynoecium and tetramerous flowers, this first character being associated with the Apocynaceae and the latter with the Scrophulariales via the Buddlejaceae. The genus *Escallonia* itself contains asperuloside, a heteroside of limited distribution but commonly occurring in the Rubiaceae (Takhtajan, 1983). The Brunelliaceae also has an apocarpous gynoecium, although in most other families of the Cornales–Rosales–Saxifragales complex the ovary is syncarpous. The Hydrangeaceae, which seems to have had a common origin with the Escalloniaceae (Takhtajan, 1983), has opposite rather than alternate leaves. Both kinds of leaf arrangements may also be found in the Asteridae. The family Alangiaceae has a flower structure and alkaloids reminiscent of the Rubiaceae (Takhtajan, 1983): furthermore, the genus *Berenice* of the Escalloniaceae appears to be a transition group between this family and the Campanulaceae. Another character in favour of the Cornales complex being a possible sister group to the Asteridae is the possession of iridoids, as are found in the less specialized members of the Asteridae, such as the Loganiaceae. Many species of the Gentianales (as defined in this paper) have been used as antimalarial treatments; it is thus interesting to note that the suspected sister group is known to have antimalarial alkaloids as well, in particular, species of *Dichroa* and *Hydrangea*, both in the Hydrangeaceae (Watt & Breyer-Brandwijk, 1962).

Fossil pollen (see Cronquist, 1988) would suggest that within the Asteridae, the Loganiaceae and Apocynaceae were possibly the first taxa to become distinct and recognizable (as we understand them today) within the subclass. The Rubiaceae may have begun to differentiate at an early stage as well, although this is not (as yet) borne out by the fossil record. However, the emergence of the Asteridae was probably not monophyletic and was possibly complicated by extensive reticulate evolution. Evidence that supports this complex reticulate, non-monophyletic evolution is the complex distribution of shared characters in extant Gentianalian–Cornalian taxa (Fig. 2).

Data associated with the Columelliaceae (whose exact systematic position has been problematic) may suggest that it is the remains of part of that archaic web of taxa that once linked the early Gentianales (and possibly Scrophulariales) to its Cornalian-like ancestor. Interpretation of presently available data also suggests that the Desfontainiaceae (included in the Loganiaceae by consensus but possibly deserving family rank of its own) may also form another such bridging taxon.

The emergence of what we now call the Loganiaceae from what must have then been an ill-circumscribed Cornalian–Rosalian–Saxifragalian root, was itself probably amorphous. Still today there are continuing problems regarding its circumscription. The tribes making up the Loganiaceae form a central web of relationships that span and connect all the other Gentianalian families and (due to its early emergence) many other families of the Asteridae as well (Fig. 2). It is interesting that within the Loganiaceae, the tribe Gelsemieae exhibits the greatest number of shared characters with the other members of the Gentianales. Bremer & Struwe (1992) also point out

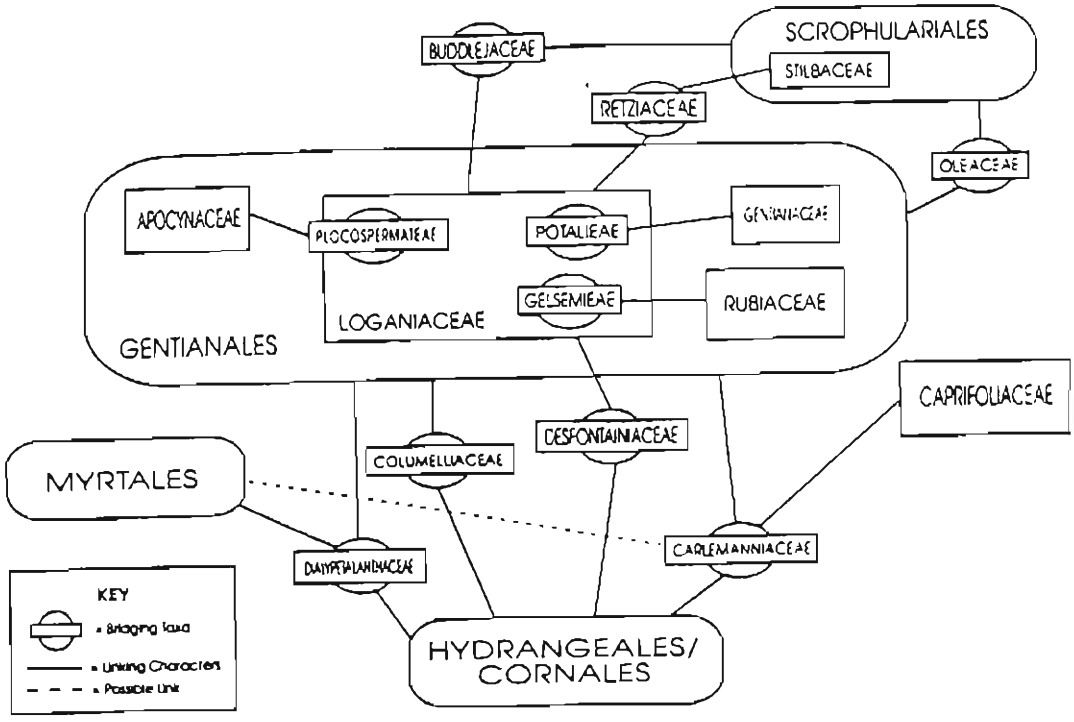

Fig. 2. Shared-character diagram for the Gentianales and some allied taxa: 1. sub-inferior ovary; 2. imbricate aestivation; 3. habit/general appearance; 4. stipules; 5. flower morphology; 6. wood anatomy; 7. bilobed fruit; 8. pollen structure; 9. chromosome number; 10. Leeuwenberg's model; 11. indole alkaloids; 12. iridoids; 13. aluminum accumulation; 14. fruit morphology; 15. valvate aestivation; 16. seed morphology; 17. Troll's model; 18. leaf morphology; 19. calyx morphology; 20. heterostyly; 21. stellate hairs; 23. glandular hairs; 24. leaf arrangement; 25. inflorescence structure; 26. lack of internal phloem; 27. triterpenes; 28. aucubin iridoids; 29. flavonoids; 30. phenolic glycosides; 31. number of antipodal cells in embryo sac; 32. nuclear endosperm; 33. micropylar endosperm haustorium; 34. progression towards a pseudomonomerous gynoecium; 35. pollen in tetrads; 36. carbocyclic iridoids; 37. serological similarities; 38. cardenolides; 39. sympetalous flowers; 40. unitegmic ovules; 41. ovules without parietal cells; 42. without internal phloem; 43. stamens isomerous with corolla lobes; 44. alternate leaves; 45. latex & laticifer system; 46. tetramerous corolla; 47. succulence; 48. uredinological data; 49. asperuloside; 50. 6-hydroxy flavones; 51. apocarpous gynoecia; 52. similar alkaloids; 53. group I iridoids; 54. seed coat similarities; 55. obliquely orientated carpels; 56. internal phloem present; 57. cellular endosperm; 58. integumentary tapetum; 59. seco-iridoids 60. convolute aestivation; 61. comose seeds; 62. 2- to 5-carpelled gynoecia; 63. carpels both free and fused; 64. carpels both superior and inferior; 65. planteose; 66. partially celled syncarpous ovary; 67. chromosome number of 9 or 11; 68. branched stigma; 69. lobate stigma; 70. molecular data (restriction site and sequencing data); 71. corolla contorted to right; 72. xanthones; 73. spicate inflorescence; 74. small annular disc surrounding ovary at base; 75. deutzioside; 76. unedoside; 77. stilbericoside; 78. actinomorphic flowers; 79. connate leaf sheath base; 80. verbascoside; 81. cornoside.

that this tribe is probably a sister group to the Rubiaceae.

Available data, particularly chemical, suggests that the Oleaceae may also be a relict taxon, bridging the proto-Gentianales and the proto-Scrophulariales. The Buddlejaceae and Retziaceae also form bridging taxa between the Scrophulariales and Gentianales, in particular with the family Loganiaceae (and possibly also the Solanales) (Fig. 2). Problems in assigning the monotypic Retziaceae to the Loganiaceae (Leeuwenberg & Leenhouts, 1980), Scrophulariales (Dahlgren, 1983), or Solanales (Cronquist, 1988) may be due to its origin at an early stage when these three orders were not as distinct as they are today.

Serological data suggest that the Caprifoliaceae may have begun to differentiate from a Cornalian-like ancestor along with the Loganiaceae (it also possesses a similar wood anatomy to our suggested bridging taxon Desfontainiaceae) and may have been near the proto-Rubiaceae, as it shares a number of morphological characters with the present-day Rubiaceae. The proto-Caprifoliaceae may in turn have given rise to the Dipsacales (Cronquist, 1981).

The many shared characters that the Rubiaceae have in common with the Loganiaceae, Apocynaceae, and Asclepiadaceae (Fig. 2) suggest that the Rubiaceae may have begun to differentiate at about the same time as the proto-Apocynaceae, although this is at present not supported by the fossil pollen record.

The many shared characters of the Loganiaceae, Rubiaceae, and Apocynaceae also suggest that the evolution of the Apocynaceae was probably not monophyletic. In particular, its very close association with the Plocospermateae in the Loganiaceae should be noted. As discussed later, the assumed monophyly of the Asclepiadaceae may also prove to be incorrect. Data suggest that the proto-Gentianaceae may have had a common ancestry with the loganiaceous tribe Potalieae.

A few comments need to be made about Figure 2, on which much of this discussion is based. In this figure shared characters have been given without weighting; however, such weighting could prove important in the final analysis because some characters, such as wood anatomy, may be phylogenetically more significant than leaf morphology, the latter being more phenotypically plastic. Also, some of the taxa in this diagram may share characters that are homoplasious and therefore of no phylogenetic significance. Homoplasy is probably widespread in these groups. Shared characters between the Rubiaceae and Gentianaceae have been omitted due to the forced, but practical, two-dimensional nature of the illustration. A three-dimensional model, if it could be created, would seem less confusing and be of more use as a symbolic representation of the shared character states. Lastly, this illustration does not show important, often unique, character states (apomorphies) that define the taxa themselves. In contrast, Figure 3 was obtained by weighting the characters. Note the isolated position of the Menyanthaceae, confirming its exclusion from the Gentianales and possibly the Solanales and Scrophulariales as well.

VI. Results

A consensus classification or consensus model for the Gentianales (Table I):

The Gentianales
Approximate number of genera = 1100
Approximate number of species = 13,050

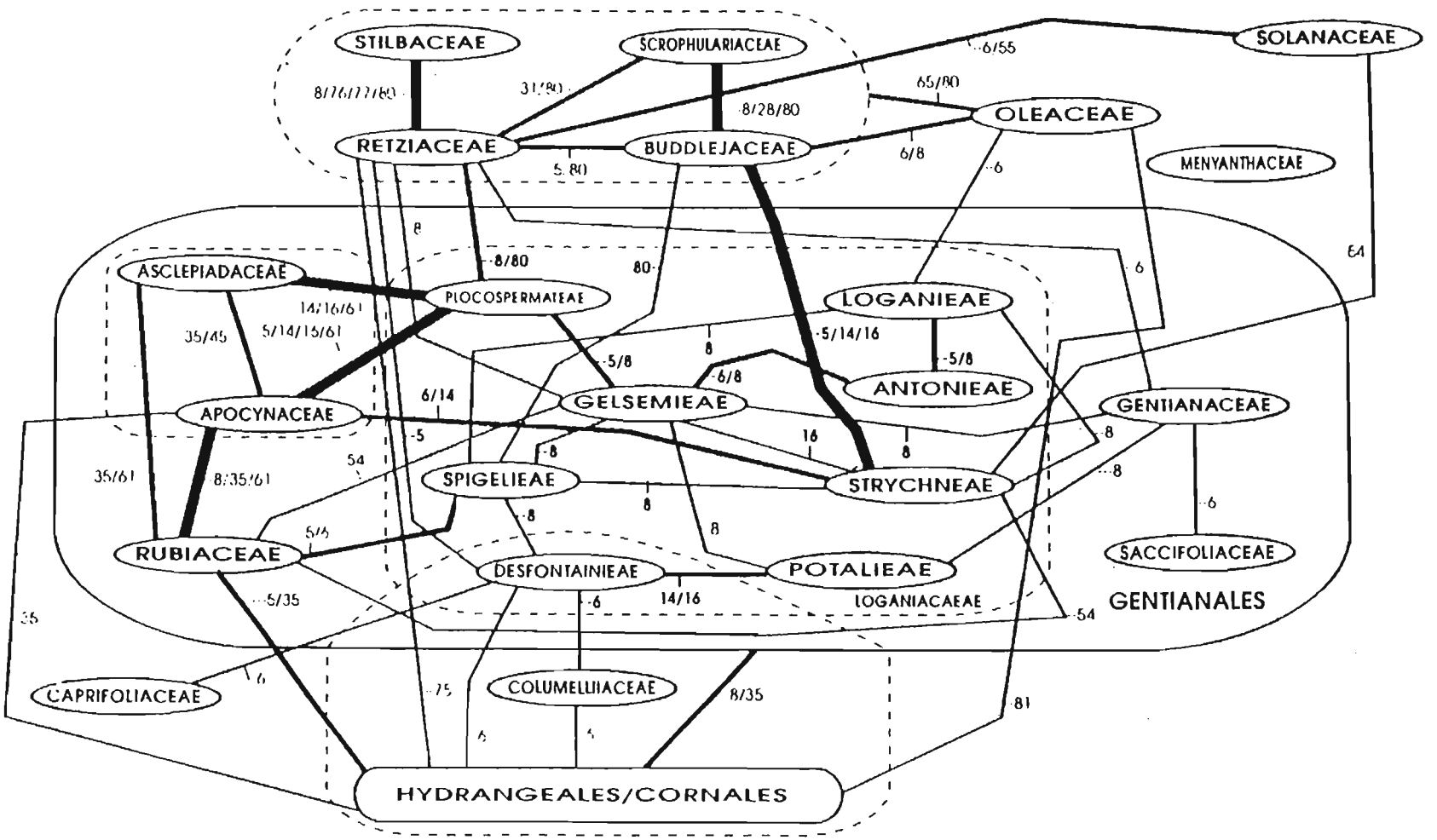

Fig. 3. Weighted shared-character diagram for the Gentianales and allied taxa (lines have been thickened according to the number of shared characters): **5.** flower morphology; **6.** wood anatomy; **8.** pollen structure; **14.** fruit morphology; **16.** seed morphology; **28.** aucubin iridoids; **31.** number of antipodal cells in embryo sac; **35.** pollen in tetrads; **45.** latex and laticifer system; **54.** seed coat similarities; **55.** obliquely oriented carpels; **61.** comose seeds; **65.** planteose; **75.** deutzioside; **76.** unedoside; **77.** stilbericoside; **80.** verbascoside; **81.** comoside.

I. Suborder Gentianineae
1. Gentianaceae (100% agreement for inclusion)
2. Saccifoliaceae (75% agreement for inclusion)
3. Loganiaceae (100% agreement for inclusion), including families Antoniaceae, Desfontainiaceae, Plocospermataceae, Potaliaceae, Spigeliaceae, and Strychnaceae
4. Rubiaceae (56% agreement for inclusion), including families Aparinaceae, Cephalanthaceae, Cinchonaceae, Coffeaceae, Galiaceae, Gardeniaceae, Guettardaceae, Henriqueziaceae, Lippayaceae, Lygodisodeaceae, Naucleaceae, Opercul ariaceae, Stellataceae, and Theligonaceae

II. Suborder Apocynineae
5. Apocynaceae (100% agreement for inclusion), including families Emeticaceae, Plumeriaceae, Vincaceae, and Willughbeiaceae
6. Asclepiadaceae (78% agreement for inclusion), including family Periplocaceae.

Families Excluded: Buddlejaceae, Carlemanniaceae, Columelliaceae, Convolvulaceae, Cuscutaceae, Dialypetalanthaceae, Menyanthaceae, Oleaceae, Retziaceae, and Salvadoraceae.

Figure 5 is a taxogram. It is based on the relationships of the taxa to each other (as inferred from their associated data) and nested according to accepted taxonomic hierarchy (Greuter et al., 1988). Although probably illustrating underlying evolutionary trends within the group, this is not what this figure represents as it is used here. The authors agree with Constance's (1964) warning that these types of illustrations become a danger only when their symbolic nature (used for easier understanding and communication) becomes confused with reality. Readers should be aware of the limitations and problems of such illustrations.

VII. Discussion

A. GENTIANALES

Lindley, *Nixus pl.* 1833.
Type family: Gentianaceae de Jussieu

Synonyms: Asclepiadaceae Brongniart (1843), **Apocynales** Hutchinson (1959), **Caprifolia** Endlicher (1836–1840) *pro parte*, **Cinchonales** Lindley (1833), **Coffeinae** Brongniart (1843), **Contortae** Bartling (1830), *nom. illegit.*, **Corolliflorae** de Candolle (1813) *pro parte, nom. illegit.*, **Loganiales** Lindley (1833), **Rubiacineae** Bartling (1830) *pro parte*, **Rubiales** Bentham & Hooker (1862–1883) *pro parte*, **Seminiflorae** Fries (1835) *pro parte, nom. illegit.*, and **Tubiflorae** Fries (1835) *pro parte, nom. illegit.*

Gentianales: Lindley, 1867: 594; Bessey, 1915: 143; Melchior, 1964: 405–424; Cronquist, 1968: 284–286; Takhtajan, 1969: 230; Swift, 1974: 302–310; Heywood, 1978b: 222–227; Benson, 1979: 261–269; Cronquist, 1981: 859–882; Takhtajan, 1983: 196–197; Goldberg, 1986: 262. **Apocynales:** Hutchinson, 1969: 422–432. **Cinchonales:** Lindley, 1867: 756–765. **Contortae:** Wettstein, 1935: 918–919; Rendle, 1967: 459–460. **Loganiales:** Hutchinson, 1969: 412–422. **Rubiales:** Bessey, 1915: 161; Benson, 1979: 332–333; Cronquist, 1968: 303–305; Cronquist, 1981: 995–1001; Cronquist, 1988: 439–441; Fernald, 1950: xxix; Hutchinson, 1969: 432–454; Rendle, 1967: 550–562.

Description: *Taxonomic statistics*: approximately 1100 genera with about 13,050 species. *Distribution*: cosmopolitan. *Habit* diverse (including parasitic, saprophytic/achlorophyllous, epiphytic, and succulent plants), sometimes with laticiferous canals (Apocynaceae and Asclepiadaceae). *Anatomy*: vessels with simple perforations, seldom scalariform perforations with few cross-bars; wood-rays usually 1–5 (–12) cells wide or lacking; internal phloem (intraxylary or interxylary) nearly always present, either as a continuous ring or as separate strands at the pith margin; superficial cork. *Leaves* opposite, occasionally whorled, rarely alternate, simple and entire, rarely compound, lobed or toothed; with (mainly but not exclusively Rubiaceae) or without stipules, interpetiolar stipules or these reduced to an interpetiolar line or colleters. *Flowers* usually regular, showy and sympetalous; actinomorphic, rarely slightly zygomorphic; bisexual, rarely unisexual. *Calyx* (2–)4–5(–12)-merous; connate or free; sometimes with basal nectary glands. *Corolla* (3–)4–5(–16)-merous but usually 5-merous occasionally 4-merous; usually convolute, occasionally imbricate or valvate; connate sometimes with corona. *Androecium*: stamens (1–)4–5(–16), but usually as many as and alternating with petals; free, connate or adnate to corolla or gynoecium. Pollen grains binucleate or trinucleate, often tricolporate and occasionally in tetrads. *Gynoecium* 2(–9) carpellate, but usually bicarpellate or occasionally 5–8-merous, rarely pseudomonomerous; syncarpous or apocarpous, (1–)2(–9) locular; usually axile or parietal placentation, rarely free central, basal or apical; superior, semi-superior or inferior. Ovules 1 to many in each locule, anatropous to hemitropous, or amphitropous; unitegmic, simple, tenuinucellar or pseudocrassinucellar (in Asclepiadaceae), usually without an integumentary tapetum; endosperm development usually nuclear, rarely cellular. *Fruits* usually a capsule or follicle, occasionally a berry, drupe or rarely a schizocarp. *Seeds* usually numerous, often comose or winged, endosperm well developed with or without oil. *Chemistry*: usually producing iridoids or alkaloids or both, as well as cardioglycosides, not strongly tanniferous, seldom cyanogenic or saponiferous, various calcium oxalate crystals present in some parenchymatous tissue cells. *Chromosome number*: $n = (5–)11(–17)$, rarely polyploid. *Economics*: members of this order are used for dyes, fiber, food, horticulture, medicines, rubber, and timber; some are extremely toxic (*Strychnos* is the source of the poison strychnine), and a few have become noxious weeds.

Of interest in this order is the plasticity of the gynoecium. Not only does the number of carpels vary from 2 to 8 (the bicarpellate condition being the norm), but also the extent to which they become modified is significant. For instance, the genus *Theligonum* L. (Rubiaceae) has a pseudomonomerous ovary while in Asclepiadaceae the ovary is both modified and also fused to the staminal whorl to form the complex gynostegium. The ovary may also vary from superior to inferior, or from being free (apocarpous) to united (syncarpous). Even within families this plasticity is of interest (Endress et al., 1983). Few other orders within the angiosperms exhibit such gynoecial plasticity, especially since this character is usually considered to be fairly conservative in terms of evolutionary change. This diversity in the ovary is reflected in the diversity of fruit types. The Gentianales, as modeled here, contains approximately 8% of all known extant angiosperm genera and approximately 5.6% of all known extant angiosperm species. Of the 30 families known to have more than 100 genera (Brummitt, 1992), 3 belong to the Gentianales: Rubiaceae (5th largest), Asclepiadaceae (9th largest), and Apocynaceae (15th largest). This means that half of the families constituting the order are among the largest known, making the order itself of some interest.

1. Key to the Families of the Gentianales

1. Plants with latex and cardioglycosides (suborder Apocynineae) 2
   2. Androecium without translator apparatus. Pollen free or in tetrads, never transferred on a spoonlike translator or forming pollinia. Usually producing iridoids . . . . . Apocynaceae
   2. Androecium producing translator apparatus. Pollen in tetrads (never free), either transported on a spoonlike translator or forming pollinia. Iridoids not produced . . . . . Asclepiadaceae
1. Plants without latex or cardioglycosides (suborder Gentianineae) 3
   3. Leaves alternate and saccate-vaginate (never opposite or whorled) . . . . . Saccifoliaceae
   3. Leaves usually opposite or whorled (never alternate or saccate-vaginate) 4
      4. Leaves without stipules or colleters . . . . . Gentianaceae
      4. Leaves with stipules (free or interpetiolar or reduced to an interpetiolar line) or colleters 5
         5. Ovary almost always superior . . . . . Loganiaceae
         5. Ovary almost always inferior . . . . . Rubiaceae

2. Suborder Gentianineae

Type family: **Gentianaceae** de Jussieu

a. Gentianaceae

A. L. de Jussieu, *Gen. pl.* 141. 1789. *nom. conserv.*

Type genus: *Gentiana* L.

Gentianaceae: Lindley, 1867: 612–614; Bentham, 1876: 799–820; Gray, 1878: 384–390; Gilg, 1895: 50–108; Bessey, 1915: 144; Wettstein, 1935: 920–922; Marais & Verdoorn, 1963: 171–243; Melchior, 1964: 408–410; Rendle, 1967: 463–468; Hutchinson, 1969: 546–552; Swift, 1974: 303; Mabberley, 1978: 223–224; Benson, 1979: 262–263; Cronquist, 1981: 871–873; Goldberg, 1986: 269–271; Airy Shaw, 1985: 483; Brummitt, 1992: 572–573.

Description: *Taxonomic statistics*: approximately 74 genera with about 1000 species. *Distribution*: global, but more common in temperate zones, even occurring in arctic and alpine regions. *Habit* usually herbs, rarely shrubby to treelike and rarely halophytic or saprophytic-achlorophyllous. *Anatomy*: xylem usually forming a continuous cylinder; internal intraxylary phloem usually present as a continuous ring or as isolated bundles at the pith margin; vascular bundles bicollateral. *Leaves* opposite, rarely verticillate (*Curtia*) or alternate (*Swertia*), simple, entire or reduced to scales (*Bartonia* and the achlorophyllous genera); scattered mucilage cells often present in the epidermis and mesophyll; petiole without stipules but occasionally with interpetiolar line. *Stems* often winged. *Inflorescence* solitary or cymose (usually dichasial, rarely monochasial), seldom racemose; bracteoles may be present even large and foliar or connate and adnate to the calyx (*Zonanthus*). *Flowers* usually showy, dioecious, rarely monoecious, usually actinomorphic, rarely dimorphic (*Hockinia*); pollination by insects. *Calyx* [2 (*Obolaria*)–] 4–5(–12)-merous; imbricate; usually with a short but well-developed tube; sometimes with basal nectary gland; lobes rarely reduced or suppressed to appear 2-cleft; rarely winged (*Canscora*) or inflated and elongated to enclose corolla (*Prepusa*). *Corolla* 4–5 [–12 (*Blackstonia*)]-merous; connate, usually with a short to long tube (*Tachiadenus*), usually plicate at sinuses; occasionally produced into spurs (*Halenia*); usually convolute, occasionally sinistrorsely contorted

(*Halenia*) or imbricate (*Obolaria*); often with scales or nectary-pits within; rarely with coronas. *Androecium*: stamens 4–5(–12), isomerous, alternipetalous, sometimes strongly zygomorphic and adnate to corolla tube or mouth, rarely some staminodal or even obsolete (*Hoppea*): anthers tetrasporangiate, usually introrse (extrorse in *Gentiana*) and dithecal; dehiscing via a longitudinal slit or rarely by terminal pores (*Exacum*); occasionally connate (*Voyria*); occasionally connective with one to two apical glands (*Sebaea*); rarely with long thread-like projections (*Urogentias*). *Gynoecium* bicarpellate, syncarpous, superior, usually unilocular and oriented in the anteroposterior plane; surrounded by nectary-disk or distinct glands; placentation parietal (this occasionally bifid) or rarely free axile, seldom bilocular with axile placentation: style simple and terminal, with entire or bilobed, papillate stigma, rarely style wanting and stigmas decurrent on ovary (*Lomatogonium*); ovules usually numerous and anatropous. *Fruit* usually a septicidal capsule or rarely a berry (*Chironia*). *Chemistry*: family rarely cyanogenic or saponiferous, iridoids present (especially gentiopicroside), accumulating xanthones and aluminum, calcium oxalate crystals present in parenchymatous tissues. *Chromosome number*: $n = 5–13$, rarely polyploid. *Economics*: Some genera of horticultural importance (*Gentiana*, *Sabatia*), occasionally of medicinal importance (*Gentiana*, *Centaurium*, and others), and the source of yellow-coloured dyes (*Blackstonia*).

There is growing support for the idea that the Potalieae of the Loganiaceae should be transferred to the family Gentianaceae (Fosberg & Sachet, 1980). In addition to other evidence, this transfer is supported by chemical data (Jensen, 1992). Wherever it is placed, the Potalieae should be seen as a taxon linking the Loganiaceae and the Gentianaceae; for further comments see under the Loganiaceae.

The Menyanthaceae and Saccifoliaceae have been included under the Gentianaceae by some authorities. However, the consensus is that, although the Saccifoliaceae is probably related to the Gentianaceae it be considered a distinct family (see also Mabberley, 1978). Consensus is that the Menyanthaceae be excluded from the Gentianales. Amongst other characters, its alternate leaves, collateral vascular bundles, valvate aestivation, embryology, and chemistry make it not only anomalous in the family Gentianaceae but also in the order Gentianales. For further comments see the discussion under these two families.

b. Saccifoliaceae

B. Maguire & J.M. Pires, *Mem. New York Bot. Gard.* 29: 230–245. 1978.
Type genus: *Saccifolium* Maguire & Pires

Saccifoliaceae: Cronquist, 1981: 873–876; Brummitt, 1992: 658–659.

Description: *Taxonomic statistics*: 1 genus, 1 species (*Saccifolium bandeirae*). *Distribution*: South America, Venezuela, Guyana Highlands. *Habit* a pulvinate subshrub. *Anatomy*: stems with well-developed strands of internal phloem. *Leaves* alternate, simple, sessile, closely crowded toward the branch tips, margins recurved, extrorsely saccate-vaginate distally; without stipules; several small glandular bodies in leaf axils. *Flowers* solitary in leaf axils, actinomorphic and dioecious. *Calyx* (4–) 5-merous, forming a short basal tube. *Corolla* 4 (–5)-merous, imbricate, connate, with well-developed tube. *Androecium*: stamens isomerous, alternipetalous and adnate to corolla-tube; anthers tetrasporangiate and dithecal, dehiscing via longitudinal slits;

connective forming a small apical point. *Gynoecium* bicarpellate, syncarpous, superior, bilocular (with apical part of partitioning imperfect); style terminal with short bilobed stigma; ovules numerous and anatropous. *Fruit* unknown. *Chemistry*: produces iridoids. *Chromosome number* unknown. *Economics*: presently none known.

This family was first described in 1978 and is thus missing from many modern classifications. The Saccifoliaceae is represented by a single species, *Saccifolium bandeirae* Maguire & Pires, which is restricted to isolated mountains in southern Venezuela. Cronquist (1981) maintained that, in combination, its unique leaves, imbricate corolla lobes, and bilocular ovary with axile placentation make the Saccifoliaceae incongruous in the Gentianaceae. He did, however, tentatively place it near this family. This approach seems to be followed by Dahlgren (1983). Thorne (1992) likewise maintains the Saccifoliaceae as a separate family, having at first (Thorne, 1983) suggested it form a subfamily, the Saccifolioideae, under the Gentianales. Takhtajan (1980) suggests (with reservation, 1983) that the Saccifoliaceae be included in the Gentianaceae, but he later (Takhtajan, 1987) seems to maintain it as a separate family (Brummitt, 1992). If the Potalieae of the Loganiaceae is accepted into the Gentianaceae (as suggested by Fosberg & Sachet, 1980), it would be hard to justify keeping the Saccifoliaceae separate, too. Benson (1979) and Goldberg (1986) seem not to have included the Saccifoliaceae in their accounts.

c. Loganiaceae

R. Brown *ex* Martius, as Loganieae in *Nov. gen. Spec.* 2: 133. 1827a. *nom. conserv.*

Type genus: *Logania* R. Brown

Loganiaceae: Endlicher, 1838: 574 *in* 1836–1840; Meisner, 1840: 257 *in* 1837–1843; Lindley, 1867: 602–605; Bentham, 1876: 786–799; Gray, 1878: 391–392; Solereder, 1892: 19–50; Bessey, 1915: 144; Wettstein, 1935: 919; Verdoorn, 1963: 134–171; Melchior, 1964: 406–408; Rendle, 1967: 460–463; Hutchinson, 1969: 412–421; Jones, 1978: 222–223; Benson, 1979: 263; Leeuwenberg & Leenhouts, 1980: 8–91; Cronquist, 1981: 865–867; Goldberg, 1986: 262–264; Airy Shaw, 1985: 681–682; Brummitt, 1992: 605.

Synonyms: Antoniaceae Hutchinson, 1959: 375; Hutchinson, 1969: 416–417; Airy Shaw, 1985: 76. **Desfontainiaceae** Endlicher, 1839: 669; 1841: 336. **Plocospermataceae** Hutchinson, 1959: 379; Hutchinson, 1969: 423–425; Airy Shaw, 1985: 921. **Potaliaceae** Martius, 1827a: 89, 133; Hutchinson, 1969: 415; Airy Shaw, 1985: 76. **Spigeliaceae** Martius, 1827b: 124, 132; Hutchinson, 1969: 418–419; Airy Shaw, 1985: 1088. **Strychnaceae** G. Don, 1837: 64; Hutchinson, 1969: 419; Airy Shaw, 1985: 113.

Description: *Taxonomic statistics*: approximately 20 genera with about 100 species. *Distribution*: pantropical, occasionally occurring in temperate regions but rarely found at high altitudes. *Habit* usually woody, often large trees, sometimes herbaceous, occasionally lianas, rarely epiphytic (*Fagraea*). *Anatomy*: nodes usually unilacunar, occasionally multilacunar (*Fagraea*); conspicuous internal, interxylary, or intraxylary phloem. *Leaves* opposite, rarely verticillate, rarely ternifolius; simple and usually entire, rarely toothed (*Desfontainia*); occasionally 3–5 nerved from above the base (*Strychnos*); usually with stipules (which are either cauducous or persistent, sometimes foliar, sometimes interpetiolar or these reduced to an interpetiolar line) or

colleters. *Stems* occasionally spiny (*Strychnos*) or with tendrils. *Inflorescence* terminal or axillary, solitary (*Desfontainia*) or cymose (usually a dichasia), rarely spikes, racemes and panicles. *Flowers* usually not large and showy; usually actinomorphic, rarely with one calyx or petal lobe enlarged (*Usteria*); usually bisexual, occasionally unisexual or polygamo-dioecious; rarely involucrate (*Coinochlamys*): Pollination is various and may even include bats (*Fagraea*). *Calyx* (2–) 4–5-merous; usually actinomorphic or rarely not so (outer lobe large and petaloid in *Usteria*); connate or free. *Corolla* 4–5 (–16)-merous; imbricate, contorted or valvate; connate; rarely with corona (*Scyphostrychnos*). *Androecium*: stamens [1 (*Usteria*)–]4–5(–16), isomerous, alternipetalous, adnate to corolla: anthers bisporangiate or tetrasporangiate, dithecal and introrse; dehiscing via longitudinal slits; usually isostylous, occasionally heterostylous (*Gelsemieae*); usually free, rarely connivent (*Gardneria*). *Gynoecium* 2 (–3–5) (pentacarpellate in *Desfontainia*); syncarpous, sometimes apically apocarpous or completely apocarpous (*Mitreola*); superior to semi-inferior (*Mitreola*); locules usually as many as carpels (except *Anthocleista* which has a false septum) but sometimes with imperfect partitions in their upper portions: style 1[–2 (*Cynoctonum*)], terminal: stigma capitate (*Strychnos*) or usually shortly lobed (*Plocosperma*) or twice dichotomously branched: ovules usually numerous, rarely as few as 1–4, placenta usually peltate or parietal, rarely basal. *Fruit* usually a septicidal capsule, rarely a circumscissile capsule (*Spigelia*), seldom a drupe (*Neuburgia*) or berry (*Potalia*) [in some the pericarp of the berry becomes thick and woody (*Strychnos*)]. *Seeds* sometimes winged (*Antonia*) or with a coma (*Plocosperma*); rarely solitary (*Plocosperma*). *Chemistry*: family producing iridoids and alkaloids (of indole & oxindole types) notable amongst these being the tryptophanic alkaloids, rarely saponiferous, sometimes accumulating aluminum. *Chromosome number*: $n = 6–12$. *Economics*: some genera are a source of indo-alkaloid poisons (*Gelsemium* and others) and glycoside poisons (loganin in *Strychnos*); a few are of horticultural importance (*Fagraea*) or used for timber (*Fagraea*).

Within the Gentianales the circumscription of the Loganiaceae has been problematic for a long time, but due to the recent reassessment of existing morphological and chemical data, as interpreted with (Bremer & Struwe, 1992) and without (Jensen, 1992) cladistics, a consensus is slowly being reached on how the family should be defined.

Following traditional thought (viz. Bentham, 1876; Solereder, 1892), Jones (1978) divided the family into two subfamilies and seven tribes. The Loganioideae contained the tribes Antonieae, Gelsemieae, Loganieae, Potalieae, Spigelieae, and Strychneae, and the monotypic Buddlejoideae contained the Buddlejeae. More recently, but also following traditional thought, Leeuwenberg & Leenhouts (1980) recognized 10 tribes within the Loganiaceae: the Antonieae, Buddlejeae, Desfontainieae, Gelsemieae, Loganieae, Plocospermateae, Potalieae, Retzieae, Spigelieae, and Strychneae. Hutchinson (1969), breaking with tradition, treated some of these as distinct families, namely, the Antoniaceae, Buddlejaceae, Loganiaceae, Potaliaceae, Spigeliaceae, and Strychnaceae, all of which he then placed in his order the Loganiales, except the Plocospermateae, which he placed in his Apocynales. Of Leeuwenberg and Leenhout's 10 tribes, the Buddlejeae, Desfontainieae, Plocospermateae, Potalieae, and Retzieae remain in dispute; these are discussed below.

Tribe Buddlejeae (= Family Buddlejaceae): The overall consensus is that this tribe should be given family status, the Buddlejaceae, and that its true affinities are

with the Scrophulariales and not the Gentianales (Airy Shaw, 1985; Cronquist, 1988; Dahlgren, 1983; Takhtajan, 1983; Wagenitz, 1977). Thorne (1983) originally placed it as a separate family in the Gentianales but later (Thorne, 1992) included the Buddlejaceae in his Bignoniales, which contained the Scrophulariaceae and its allies. The consensus is that this taxon be removed from the Gentianales.

Tribe Desfontainieae: This monotypic tribe occurs along the mountainous backbone of South America from Costa Rica to Cape Horn. It has often been given family status, the Desfontainiaceae (Dahlgren, 1983; Takhtajan, 1969) within the Gentianales. Later, however, Takhtajan (1983) went on to include the family, with reservations, in the Loganiaceae. Cronquist (1968) included it as a tribe in the Loganiaceae. Thorne in 1983 considered it a separate subfamily under the Loganiaceae, then in 1992 revived its family status but transferred it to his order Hydrangeales in the Cornanae. Data suggest that *Desfontainia* Ruiz & Pavón may be a bridging taxon between the Cornanae and Loganiaceae and these authors see merits in including it, *at family level*, in either the Gentianales as defined in this paper or Cornanae *sensu* Thorne (≡Rosales of Cronquist or Saxifragales of Takhtajan). Bisset et al. (1980) confirm the isolated or incongruous morphology of *Desfontainia* as compared with the rest of the Loganiaceae *sensu* Leeuwenberg & Leenhouts (1980), although it should be mentioned that they opt for keeping it in this family.

Tribe Plocospermateae: Hutchinson (1969) gave this taxon family status, the Plocospermataceae, and placed it in his Apocynales rather than his Loganiales. In fact, although most authorities continue to include this monotypic tribe in the Loganiaceae [Thorne (1992), accorded it subfamily rank, Plocospermatoideae], its almost intermediate position between the Loganiaceae and Apocynaceae is generally acknowledged (Takhtajan, 1969, 1983; Thorne, 1976); see also Figure 3. Cronquist (1981) went as far as including this taxon in the family Apocynaceae rather than the Loganiaceae but gave it no rank of its own. Dahlgren (1983) made no mention of the taxon. The Plocospermateae illustrates rather effectively the taxonomic and nomenclatural problems posed by intermediate or "bridging taxa." Such taxa are often encountered and are always useful in understanding relationships and evolutionary trends (Fig. 4). The one rather noticeable exception to the almost universal consensus regarding the nearest relatives of the Plocospermateae seems to be Jensen (1992), who suggests, on chemical grounds, that this monotypic tribe be placed outside the Gentianales near the families Scrophulariaceae or Oleaceae; but this does not concur with strong morphological data. The Plocospermateae consists of a single species, *Plocosperma buxifolium* Bentham, which occurs in southern Mexico and in Guatemala.

Tribe Potalieae: There is growing anatomical and chemical evidence to suggest the transfer of the Potalieae to the Gentianaceae (Fosberg & Sachet, 1980; Jensen, 1992); however, even if this is not done, the close connection between this tribe and the Gentianaceae is at present not disputed. This tribe consists of three genera: *Potalia* Aublet, found in northern South America, *Anthocleista* Afzelius in tropical Africa and Madagascar, and *Fagraea* Thunberg in Australasia.

Tribe Retzieae (= Family Retziaceae): Now usually given its own family, the Retziaceae. This taxon is variously placed depending on how associated data is interpreted. Following Wettstein (1891), Cronquist (1988) and Hutchinson (1969) considered the Retziaceae to be a separate family related to the Solanaceae and its allies. Dahlgren et al. (1979; Dahlgren, 1983) suggested an association with the Stilbaceae in his order Scrophulariales. Thorne at first gave this taxon subfamily status

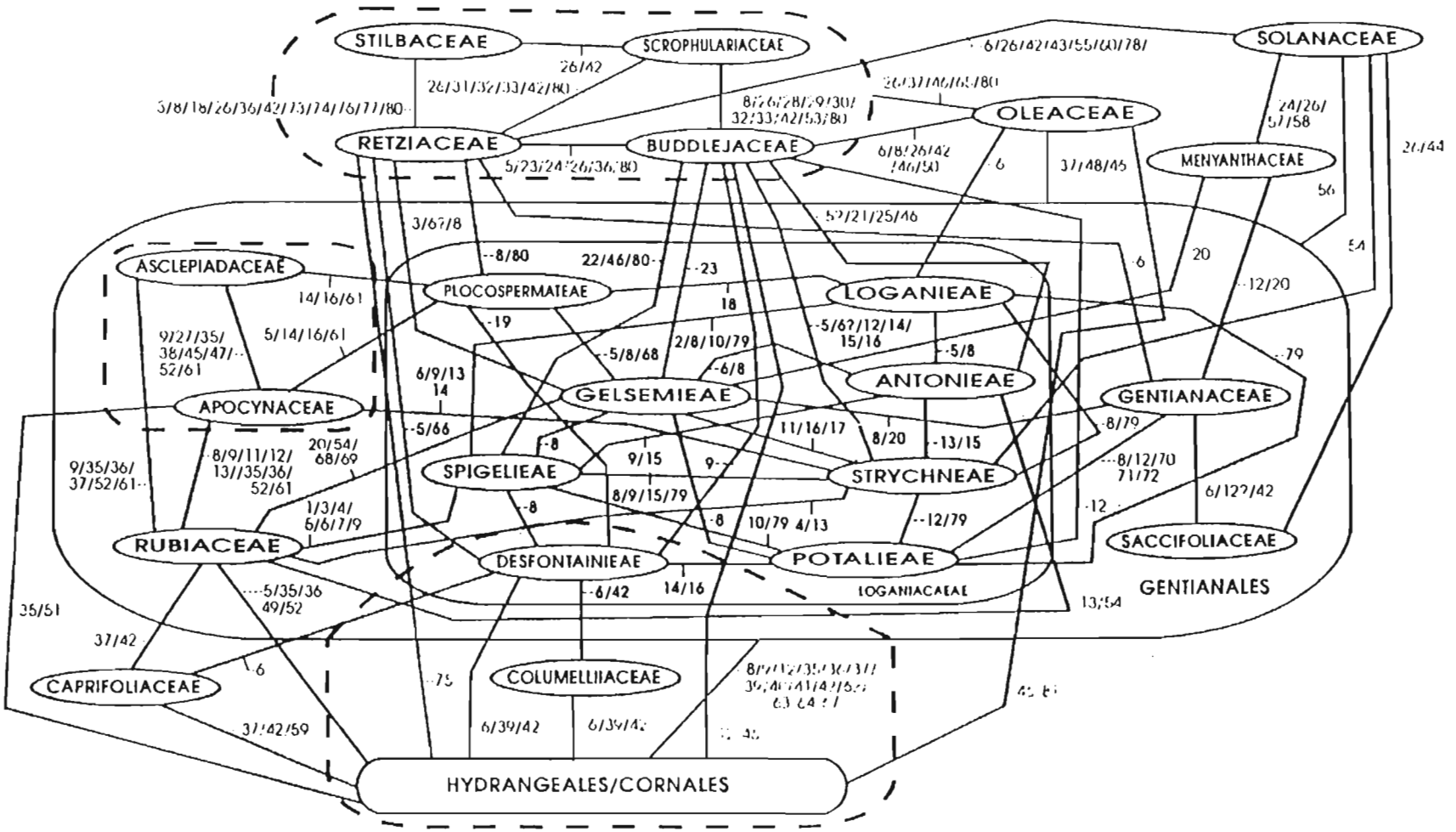

Fig. 4. Diagrammatic representation of bridging taxa and the groups they link.

under the Loganiaceae (1983); then, in 1992, following Dahlgren and co-workers' line of thought, he transferred this subfamily to the family Stilbaceae in his Bignoniales. Takhtajan (1980, 1983) placed this family in the Scrophulariales near the Scrophulariaceae and Buddlejaceae. Although there is no consensus for its exact placement, agreement seems to be that the tribe Retzieae/family Retziaceae should not be placed within the Gentianales.

Tribes Antonieae, Gelsemieae, Spigelieae, and Strychneae (i.e., the residue of tribes) form the core of the family—viz. Loganiaceae *sensu stricto*. However, there are a few anomalies even here. The wood anatomy and fruits of *Neuburgia* (of the Strychneae) are unique in the Loganiaceae but more common in the Apocynaceae. This may suggest (along with evidence from the Plocospermateae) that the evolution of the Apocynaceae itself is paraphyletic or at least reticulate. *Neuburgia* also has stipules similar to those of the Rubiaceae (Leeuwenberg & Leenhouts, 1980). The Loganiaceae *sensu consentaneus* would also include the Desfontainieae, Plocospermateae, and Potalieae. By consensus the Buddlejaceae and Retziaceae are excluded from the Gentianales altogether. Only Leeuwenberg and Leenhouts (1980) make a strong plea for their continued inclusion in the Loganiaceae.

Phylogenists may have to look again at the inclusion of some of the tribes included in the Loganiaceae by consensus, because studies by Bremer and Struwe (1992) indicate that the evolution of the family (minus the Retzieae and Buddlejeae) is paraphyletic. They also suggest that the tribe Gelsemieae is a possible sister group to the Rubiaceae, and they discount the genus *Mitreola* L. ex Schaeffer (tribe Spigelieae) as being a possible connecting group between the Loganiaceae and Rubiaceae as suggested by Thorne (1976). It should be mentioned as a warning that the name *Mitreola* as used in the older literature was surrounded by some nomenclatural and taxonomic confusion.

Within the Gentianales, the Loganiaceae is unusual because of its possible evolutionary connection to three separate families, viz. to the Gentianaceae through the Potalieae, to the Apocynaceae through the Plocospermateae, and to the Rubiaceae through either the genus *Mitreola* (Thorne, 1976) or tribe Gelsemieae (Bremer & Struwe, 1992) (Fig. 5). There may even be a connection with this family to the Scrophulariales *sensu* Cronquist through the Buddlejaceae. The Loganiaceae (which is primarily woody and generally less specialized for insect pollination) would seem to be near the central base from which the order Gentianales arose.

d. Rubiaceae

Jussieu, *Gen. pl.* 196. 1789. *nom. conserv.*

Type genus: *Rubia* L.

Rubiaceae: Hooker, 1873: 7–151; Gray, 1878: 208; Schumann, 1891: 1–156; Bessey, 1915: 161; Wettstein, 1935: 933; Melchior, 1964: 417–422; Hutchinson, 1969: 432–455; Rendle, 1967: 552 –562; Kupicha, 1978: 257–259; Benson, 1979: 333; Swift, 1974: 338–339; Cronquist, 1981: 995–1000; Goldberg, 1986: 267–269; Airy Shaw, 1985: 1008–1010.

Synonyms: Aparinaceae Hoffmansegg & Link. **Cephalanthaceae** Rafinesque. **Cinchonaceae** Batsch; Lindley, 1867: 761. **Coffeaceae** Batsch. **Cynocrambaceae** Nees. **Galiaceae** Lindley. **Gardeniaceae** Dumortier. **Guettardaceae** Batsch. **Henriqueziaceae** (Hooker *f.*) Bremekamp; Airy Shaw, 1985: 548, **Lippayaceae**

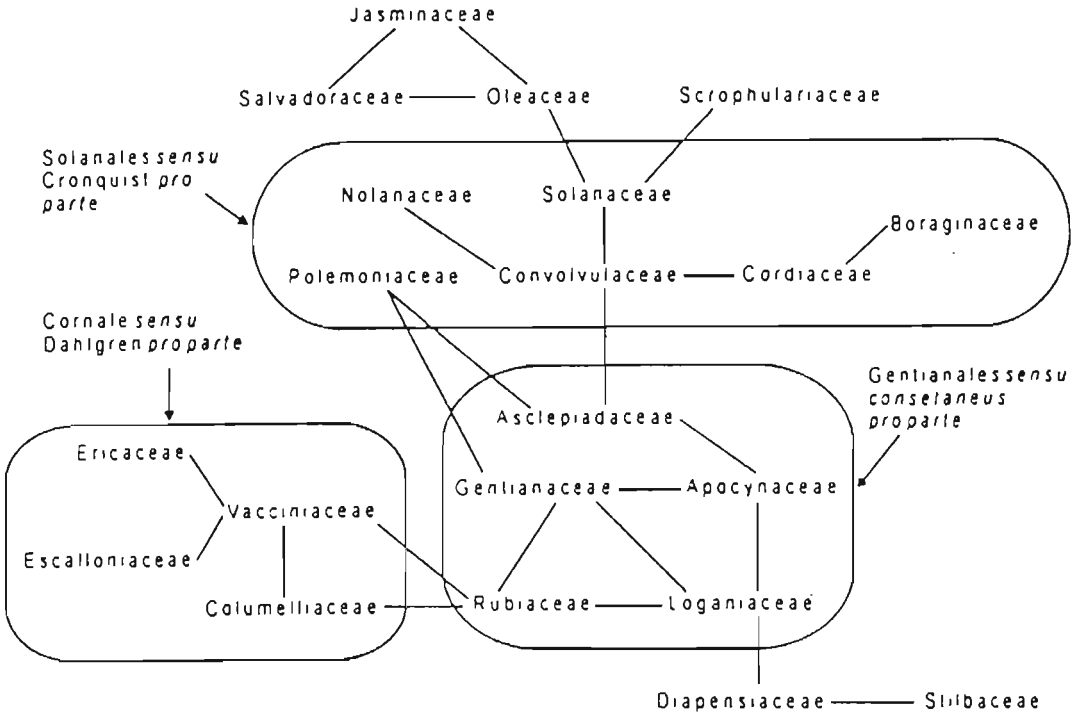

Fig. 5. Taxogram of the Gentianales.

Meisner. **Lygodisodeaceae** Bartling. **Naucleaceae** Wernham; Airy Shaw, 1985: 779. **Opercul**ariaceae Dumortier. **Stellataceae** Dulac. **Theligonaceae** Dumortier; Airy Shaw, 1985: 1145.

Description: *Taxonomic statistics*: approximately 600 genera with about 7500 species. *Distribution*: global, mostly tropical, occasionally temperate, rarely arctic (*Galium*). *Habit*: herbs (annual or perennial), shrubs or trees, rarely succulent (*Theligonum*) or epiphytic (*Hydnophytum*), some genera myrmecophilous (*Myrmecodia* and others). *Anatomy*: sometimes with anomalous secondary growth, lacking internal phloem. *Leaves* usually opposite or appearing whorled (*Gardenia*), rarely alternate by suppression of one member of a pair at each node (*Didymochlamys*), or upper leaves alternate and lower leaves opposite (*Theligonum*); simple; usually entire, rarely lobed; interpetiolar stipules present; these may become foliar in nature, increase in number, become connate to encircle the stem or become reduced to an interpetiolar line, less often stipules petiolar (*Theligonum*); usually with colleters. *Stems* rarely spiny (*Catesbaea*), tuberous (*Myrmecodia*) or leafless (*Phyllacantha*). *Inflorescence* mostly cymose (usually a small dichasia or a much branched cymose panicle), rarely solitary or sessile (*Theligonum*). *Flowers* actinomorphic or very rarely zygomorphic (*Dorothea*); bisexual or rarely unisexual; nearly always epigynous; often heterostylic (*Cinchona*): pollination zoophilous (mainly entomophilous, especially Diptera, Hymenoptera, and Lepidoptera) or rarely anemophilous (*Theligonum*). *Calyx* (2–) 4–5-merous, lobes often small, at times even obsolete or sometimes even enlarged and showy (*Mussaenda*). *Corolla* (3–) 4–5 (8–10)-merous or absent in staminate flowers (*Theligonum*); aestivation valvate, imbricate or convolute; connate; usually actino-

morphic or slightly zygomorphic to bilabiate (*Ferdinandusa*); rarely staminal flowers forming a pseudanthium (*Theligonum*). *Androecium*: stamens (2–) 7–12 (–30) (6–30 in *Theligonum*), usually isomerous, alternipetalous, adnate to corolla tube or corolla mouth: filaments rarely connate (*Neurocalyx*) or strongly unequal: anthers tetrasporangiate, dithecal, dehiscing via longitudinal slits or rarely by pores (*Argostemma*); rarely connivent (*Argostemma*); sometimes connective produced apically. *Gynoecium* 2(–3–9)-merous, usually bicarpellate, syncarpous, inferior, rarely semi-inferior (*Synaptantha*) or superior (*Gaertnera* and *Pagamea*); ovary with as many locules as carpels (in which case placentation is axile or a derivative), seldom unilocular (*Gardenia*) (in which case placentation is parietal) or pseudomonomerous (*Theligonum*): style usually one and slender or styles free (*Galium*), rarely basilateral (*Theligonum*), or even missing (*Tetralopha*): stigma capitate or lobed: ovules 1 to many in each locule; anatropous to hemitropous, or campylotropus (*Theligonum*); solitary, basal, without integumentary tapetum. *Fruit* a (septicidal or loculicidal) capsule, berry, drupe or dry and indehiscent or a schizocarp, sometimes dicoccous (*Galium*), rarely a nutlet (*Theligonum*). *Seeds* usually without a coma, rarely with, or very rarely arillate (*Isidorea*). *Chemistry*: family accumulates aluminum and produces triterpenes, iridoids, anthraquinones, various alkaloids (especially indole, but also quinoline, isoquinoline, and purine), and proanthocyanins, sometimes tanniferous and saponiferous, seldom cyanogenic. *Chromosome number*: $n = 6–17$, usually 11, less often 9. *Economics*: the source of coffee (*Coffea*), emetin (*Cephaelis*), dyes (*Rubia*), quinine (*Cinchona*), and drugs (*Cephaelis*); many are of horticultural interest (*Gardenia* and many others); the young shoots of *Theligonum* are used as a vegetable.

Due to the accumulation of significant evidence, there is growing consensus amongst macrosystematists that the Rubiaceae is as closely related to the Apocynineae as are its traditional relatives, namely, the Loganiaceae and Gentianaceae (Wagenitz, 1959). This closeness has been recognized in the classifications of Dahlgren (1980), Takhtajan (1969, 1980, 1983), and Thorne (1976, 1992), who included the Rubiaceae in the order Gentianales. Phylogenists such as Cronquist (1981, 1988), Hutchinson (1969), and Kupicha (1978), although recognizing the evolutionary association of these taxa, preferred to place the Rubiaceae in a separate order, the Rubiales. Cronquist (1981) was reluctant to place the Rubiaceae in the Gentianales because he felt that it could with equal justification also be placed in the Dipsacales, with which he said it had affinities. Takhtajan (1969), although not going this far, nevertheless maintained that the Gentianales, including the Rubiaceae, had a common origin with the Dipsacales. Wagenitz (1977), on the other hand, believed the Dipsacales to be nearer the Scrophulariales than the Gentianales, while Bremer and Struwe (1992) believed the similarities of the Rubiaceae to the Dipsacales to be superficial. Interestingly, Thorne (1992) placed the Dipsacales in his Cornanae rather than his Asteranae (which includes the Gentianales). This is not at odds with a great deal of available data which tends to suggest that the Cornanae and Asteranae had some common starting point. Lee and Fairbrothers (1978), combining multifarious data with serological information, go so far as to suggest that the Rubiaceae is more closely related to the Cornaceae and Nyssaceae than to the Gentianales and Dipsacales. Unfortunately, their study left out the Loganiaceae as well as representative elements of the Solanales and Scrophulariales, all of which are pivotal to understanding relationships within and between these related groups. Cronquist's comments (1981: 1009) concerning the Lee and Fairbrothers study (1978) should also be noted. The vast mass of evidence,

however, continues to tie the Rubiaceae to the Gentianales, and the main contribution of Lee and Fairbrothers's serological results is that it strengthens the growing support for considering the Cornanae to be more closely related to the Gentianales than was previously thought.

The results of Bremer and Struwe's (1992) cladistic study seem to indicate that the tribe Gelsemieae (Loganiaceae) could be the closest extant relative of the Rubiaceae. This does not agree with suggestions by Takhtajan (1980) and Thorne (1976) that the genus *Mitreola* (Spigelieae: Loganiaceae) is somewhat intermediate between these two families. It should also be noted that two other genera of the Rubiaceae, *Gaertnera* Lamarck and *Pagamea* Aublet, which have superior ovaries, had erroneously been placed in the Loganiaceae at one time (Cronquist, 1988). It is such data that probably led Thorne (1976) to say that "the Rubiaceae seem little more than inferior ovaried loganiaceous cousins," a statement with which anyone who has had to construct an analytical key to the two families would concur. However, some important differences (anatomical and pollen morphology in particular but also, to a degree, chemical) do exist between these two families and should not be undervalued.

The infrafamilial classification of the Rubiaceae is controversial (Kupicha, 1978) and nomenclaturally complicated (Darwin, 1976; see also Bremekamp, 1966; Robbrecht, 1988; Verdcourt, 1958). There is almost total agreement by present-day phylogenists and experts in the family that the following families should be considered synonymous with the Rubiaceae: Cephalanthaceae, Cinchonaceae, Coffeaceae, Gardeniaceae, Guettardaceae, Lippayaceae, Lygodisodeaceae, and Opercul ariaceae. In contrast, there has been some recent debate on the status of the families Henriqueziaceae, Naucleaceae, and Theligonaceae. However, consensus is that even these be included in the Rubiaceae. By consensus, another, usually separate family, the Dialypetalanthaceae, has been excluded.

Dialypetalanthaceae: Cronquist (1968, 1981), Dahlgren (1980), and Hutchinson (1969) placed the Dialypetalanthaceae near the Rubiaceae. Cronquist (1988) later changed his mind and placed the family in his Rosales. Goldberg (1986) and Stebbins (1974) suggested that the family be placed in the order Myrtales, while Dahlgren (1980), Takhtajan (1983), and Thorne (1983) placed the family in the Gentianales. However, present consensus seems to be that it is not part of the Gentianales. The fact that the Dialypetalanthaceae show characteristics found in the Myrtales, Cornales, and Gentianales suggests that it may represent a particularly archaic and somewhat isolated group (all its closest relatives now being extinct) with connections to all three of these modern orders.

Henriqueziaceae: This family was split off from the Rubiaceae by Bremekamp (1957); however (although its irregular corolla and lack of both endosperm and colleters do make it unusual within the Rubiaceae), his ideas are generally not followed by most modern phylogenists (Dahlgren, 1983; Hutchinson, 1969; Takhtajan with reservation, 1969; Thorne, 1992). Airy Shaw (1985) agreed with the separation of this family, stating that it was erroneously included in the Rubiaceae because it possessed stipules and that its closest relatives are the Bignoniaceae, Pedaliaceae, and Thunbergiaceae (this latter usually included in the Acanthaceae). On the other hand, Cronquist (1981) pointed out that the genus *Gleasonia* Standley tends to bridge the gap between *Henriquezia* Spruce *ex* Bentham and the rest of the Rubiaceae, making separation unfeasible. Thorne (1983) made something of a compromise by giving the taxon subfamily status, Henriquezioideae, under the Rubiaceae, but later (Thorne,

1992) sank it back into the subfamily Rubioideae. The two genera involved, *Henriquezia* and *Platycarpum* Humboldt & Bonpland, are found in northern tropical South America, in particular, Brazil.

Naucleaceae: This family, first proposed by Wernham in 1912, is usually accepted into the Rubiaceae by most phylogenists (Cronquist, 1981; Hutchinson, 1969; Takhtajan, 1969); however, none gives reasons for doing so. Others, such as Dahlgren (1983), Stebbins (1974), and Thorne (1992), make no mention of the taxon. Interestingly, members of this taxon have a slightly combretaceous appearance (Airy Shaw, 1985). The Combretaceae form part of the Myrtales, which seems to have had a distant but common origin with the Gentianales from a proto-cornalian-like ancestor. In light of the myrtalian connection of the Dialypetalanthaceae (often associated with the Rubiaceae), the possible myrtalian connection of the Naucleaceae (usually included in the Rubiaceae) could be significant. Alternatively, parallel evolution could be at work. Whichever is true, this group of 10 genera requires more thorough investigation.

Theligonaceae (Syn.: Cynocrambaceae): Wunderlich (1971), who completed a thorough revision of *Theligonum* L., suggested it be placed in the Rubiaceae in its own tribe, the Theligoneae. However, despite this work, the rank and taxonomic position of this taxon has continued to vary greatly. Cronquist (1981, 1988) treated this monotypic family as separate from the Rubiaceae but included it in his bitypic Rubiales. Dahlgren (1983) kept it as a separate family within the Gentianales, as did Takhtajan (1980, 1983), although Takhtajan did question the validity of this family status. Thorne (1976, 1992) included the Theligonaceae in the Rubiaceae, specifically sinking *Theligonum* into the subfamily Rubioideae. Bremer and Struwe (1992) report the Rubioideae to be monophyletic, but unfortunately they do not state whether they included the Theligonaceae (and therefore associated data) as a synonym under this taxon. Heathcote (1978) and, with reservations, Stebbins (1974) placed the Theligonaceae under the order Haloragales (along with Haloragaceae, Gunneraceae, and Hippuridaceae). Airy Shaw (1985) also mentioned the possible connection of this taxon to the Caryophyllidae, especially the family Portulacaceae, while Goldberg (1986) and Hutchinson (1969) actually placed it in the Caryophyllales. Historically, Bentham (1880) placed this genus in the Urticaceae. By consensus this taxon is now included in the Rubiaceae, although a good case could be made for retaining this as a separate family in the Gentianales allied to the Rubiaceae. *Theligonum* contains three species and has an odd, disjunct distribution: It is found on the Canary Islands in the Atlantic Ocean, in the Mediterranean, and then (after a gap of thousands of miles) in southwestern China and Japan. *Theligonum* is myrmecochorous.

3. Suborder Apocynineae

Benson *ex* Rosatti, *J. Arnold Arbor.* **70:** 307–401. 1989a.

Type family: **Apocynaceae** de Jussieu

Apocynineae: Benson, 1979: 124–356.

Discussion:

The Apocynineae consists of the Apocynaceae and Asclepiadaceae (the latter family including the Periplocaceae). Within the Gentianales, the families of the Apocynineae are unique in being the only ones to have a totally apocarpous ovary. This is unusual because this suborder is strongly characterized by the synorganization of its flowers; in fact, the Asclepiadaceae has the most synorganized flowers within the dicotyledons. The Asclepiadaceae *sensu* Rosatti (1989a, 1989b) also stands out because of the

numerical constraints placed on its flower and fruit; this should be contrasted with the other family in the suborder, the Apocynaceae, in which the flower has fewer constraints (Endress, 1990) and the fruit is diverse. The different floral, numerical constraints between these two otherwise closely related families is not often emphasized as a major disjunction between these two taxa.

Taxonomically, the Apocynaceae, Asclepiadaceae, and Periplocaceae have been treated in different ways by various authorities. Bullock (1956), Dyer (1975), Hutchinson (1969), and Schlechter (1905, 1924) have all maintained these as separate taxa at the family level, while Cronquist (1981), Dahlgren (1980), Rosatti (1989a, 1989b), and Takhtajan (1983) have included the Periplocaceae under the Asclepiadaceae as the subfamily Periplocoideae. Safwat (1962), Stebbins (1974), and Thorne (1976, 1992) proposed that all three be included in an expanded Apocynaceae—an older classificatory concept apparently with growing modern support (Rosatti, 1989a).

All these classifications recognize the differences between these three taxa; they differ only in the way they express these differences using the presently accepted system of hierarchy. Whereas workers such as Schlechter maximize the differences, other workers such as Thorne minimize them. While modern literature is cited here, this particular dilemma dates back to the 1800s (see comments by Rosatti, 1989a; Woodson, 1930), and, in fact, R. Brown (1810) himself stated that on this matter botanists are "almost equally divided." It is interesting that some 180 years later this can still be said to be true.

Robert Brown (1810), who proposed the Asclepiadaceae [thus splitting the Apocynaceae of de Jussieu (1789) into two almost equal taxa], considered both families to be part of a continual or natural series. It is this unity that Thorne (1976, 1992) is attempting to express in his classification. In 1989, when Rosatti proposed the suborder Apocynineae (following Benson, 1979), he did so to emphasize the close relationship between the Apocynaceae and Asclepiadaceae without compromising the few differences between them. However, at the family level, Rosatti's classification is congruent only if the taxa involved are monophyletic.

If the monophylism of these taxa, as suggested by Rosatti (1989a) and Safwat (1962) (viz. following the evolutionary line: Apocynaceae → Periplocoideae → Secamonoideae → Asclepiadoideae) is true, then the integrity of the taxa is not in dispute and only the level at which they are accorded recognition is open to discussion. Therefore, at present, the debate is not centered on hard empirical data but on personal interpretation of the use of hierarchy and the way taxonomists mentally define taxa (Clayton, 1974; Loevtrup, 1987; McNeill, 1979; Stevens, 1990; Walters, 1961). However, if the taxa of the Apocynineae are paraphyletic, then the nature of the debate must change (Bremer & Wanntorp, 1978). The staminal, pollinial, and coronal data given by Safwat (1962) which has been widely and uncritically used by other workers is open to differing interpretation and does not necessarily support a monophyletic line from the Apocynaceae through the Periplocoideae and Secamonoideae to the Asclepiadoideae.

Although not the norm, some Apocynaceae and some Periplocoideae are characterized by successive meiotic divisions of the two pollen mother cells, as in the Asclepiadoideae, while in *Secamone* R. Brown it is always simultaneous. This could be argued as evidence for paraphyletic rather than monophyletic evolution amongst the taxa. Likewise, the differing locular maturation in the anthers of the Plumerioideae and Apocynoideae could support paraphyly. That is, the equal locular development

Table II

A comparison of characters in the five subfamilies of the suborder Apocynineae. It can be seen that it is difficult to deduce either a monophyletic or paraphyletic evolution for the Asclepiadaceae from this data alone. (Data obtained from sources cited within the text of this paper.)

	Apocynaceae			Asclepiadaceae		
Character	Plumerioideae	*	Apocynoideae	Periplocoideae	Secamonoideae	Asclepiadoieea
trees		✓		✗	✗	✓
herbs		✓		✓	✗	✓
climbers		✓		✓	✓	✓
succulents		✓		✗	✗	✓
leaves lobed		✗		✗	✗	✓
flowers 4-merous	✓		✗	✗	✗	✗
flowers 5-merous	✓		✓	✓	✓	✓
nectaries present		✓		✗	✗	✗
nectar from stigmatic chamber		✗		✓	✓	✓
corolline corona		✓		✓	✓	✓
staminal corona		✗		✓	✓	✓
stamens connivent on stigma	✗		✓	✓	✗	✓[a]
stamens adnate to stigma		✗		✗	✓	✓
apical dehiscence of anthers		✗		✗	✗	✓
longitudinal dehiscence of anthers		✓		✓	✓	✗
4 anther locules equally developed	✓		✗	✓	✓	✗
suppression of 2 anterior anther locules	✗		✓	✗	✗	✗
2 anterior anther locules missing		✗		✗	✗	✓
simple anther slit	✗		✓	✓	✓	✓
double anther slit		✗		✗	✗	✓
pollinarium with stalk		✗		✓	✗	✗
pollinarium with spoon		✗		✓	✗	✗
translator apparatus present		✗		✗	✓	✗
corpusculum present		✗		✗	✗	✓
mechanical fixation of corpusculum to style-stigma head		✗		?	✗?	✓?
corpusculum glued to style-stigma head		✗		?	✗	✓
corpusculum glued to anther wings		✗		?	✓	✗
corpusculum deeply furrowed		✗		✗	✗	✓
corpusculum not deeply furrowed		✗		✗	✓	✗
translator arms present & well defined		✗		✗	✗	✓
2 ends of pollen mother cells not always the same width		?		?	✓	✗
2 ends of pollen mother cells the same width		?		?	✗	✓
pollen mother cells undergo 2 simultaneous meiotic divisions		✓		✓	✓	✗
pollen mother cells undergo 2 successive meiotic divisions		✓		✓	✗	✓

continued

Table II (continued)

Character	Apocynaceae: Plumeroideae	Apocynaceae: *	Apocynaceae: Apocynoideae	Asclepiadaceae: Periplocoideae	Asclepiadaceae: Secamonoideae	Asclepiadaceae: Asclepiadoieea
pollen in separate grains		✓		✗	✗	✗
pollen in tetrads		✓		✓	✓	✓
tetrads decussate		✓		✗	✗	✗
tetrads tetrahedral		✓		✓	✗	✗
tetrads isobilateral		✓		✓	✗	✗
tetrads T-shaped		✗		✓	✓	✗
tetrads rhomboidal		✗		✗	✓	✗
tetrads linear		✗		✓	✗	✓
pollinia present		✗		✗	✓	✓
pollinia 4		✗		✓	✓	✓
pollinia 2		✗		✗	✗	✓
more than two carpels	✓		✗	✗	✗	✗
carpels not free in ovule bearing region	✓		✗	✗	✗	✗
carpels free in ovule bearing region		✓		✓	✓	✓
carpels subinferior	✓		✗	?	✓	✓
carpels superior	✓		✓	✓	✗	✓
sterile placenta margins directed down	✓		✓	?	✗	✓
sterile placenta margins directed up	✓?	✗[b]	✗	✗	✓	✗
stigma secretes viscous substance as in *Lochnera*	✓		✗	✗	✗	✗
stigmatic head secretory all over	✓[c]		✗	✗	✓	✗
stigmatic head secretory in 5 areas only		✓		✓	✗	✓
stigma on basal part of stigma-style head		?		?	✗	✓
stylar canals present for pollination		?		?	✓	✓
stylar canals not present		?		?	✗	✓
styles free		✗		✓	✓	✓
styles connate		✓		✗	✗	✗
fruits are capsules, berries or drupes	✓		✗	✗	✗	✗
fruits are follicles	✓		✓	✓	✓	✓
seeds with a coma of hair	✗		✓	✓	✓	✓
endosperm with central cavity		✓		✗	✗	✗

[a]Only in *Xysmalobium barbigerum*?
[b]Except *Mandevilla*?
[c]Only in *Baissea*?
*Literature source makes reference only to Apocynaceae

of the Plumerioideae could have given rise to the four-pollinial state in *Secamone* while the trend towards the underdevelopment of the two adaxial locules in the Apocynoideae (Demeter, 1922) could have resulted, if taken to its ultimate conclusion, in the two-locular state found in the Asclepiadoideae. In contradiction to this, however, Woodson (1930) points out that in *Apocynum* L., *Poacynum* Baillon, and *Trachomitum* Woodson (Apocynaceae) the partition of adaxial and abaxial locule pairs ruptures to give the appearance of a bilocular anther, a condition he says could suggest affinities

to the bilocular Asclepiadaceae. The odd stigmatic morphology of *Secamone* is also not quite congruous with a monophyletic theory, for, despite Safwat's (1962) interpretation, this structure remains anomalous in the Apocynineae. Within the Asclepiadaceae *sensu* Cronquist (1981), the nature of corpusculum attachment to the style-stigma head in *Secamone* (Kunze, 1991) is also anomalous (see Table II).

Other datum, not quite agreeing with a monophyletic evolution for the group, is the upwardly directed sterile placenta margins of *Secamone*, a character apparently shared with *Mandevilla* Lindley of the Apocynoideae (*Mandevilla* is also interesting because it produces unusual disk-like glands that resemble the translator apparatus of the Periplocoideae). In most other Apocynaceae and Asclepiadaceae these sterile margins are downwardly directed (Safwat, 1962; Woodson & Moore, 1938). Also, both superior and sub-inferior carpels are found in the Apocynaceae, while in *Secamone* they are sub-inferior and in Asclepiadaceae they are superior. This conflicting data may also tend to argue in favour of a paraphyletic evolution.

The fact that the Periplocoideae, *Secamone*, and *Fockea* Endlicher all lack structures that could be precursors of the caudicles or translator arms found in the rest of the Asclepiadaceae also lays a monophyletic evolution open to some doubt. In fact, Kunze (1993), in a thorough study of the translator of the Periplocoideae and Asclepiadaceae, states: "The occurrence of functionally similar structures in the more highly evolved Asclepiadaceae is most probably a case of parallel evolution." Having said this, he then suggested a monophyletic evolution for the group (based on translator structure and ontogeny) as a whole, with the evolutionary line as follows: Periplocoideae → Secamoneae → *Fockea* → Asclepiadaceae. However, this trend, although of considerable merit, does not fit well with pollinial data, in particular, the four-pollinial state of *Secamone*, which is anomalous in the line suggested.

Also, depending on interpretation, the jump from sticky tetrads to well-defined pollinia (with no intermediate stages known) could be considered quite large by some. Such an all-or-nothing character could support an evolutionary disjunction between these two taxa. Further, although the absence of the periplocaceous pollination spoon in *Secamone* can be interpreted as being lost through reduction (monophyly), it can also be interpreted as never having been present in the evolution of *Secamone* (paraphyly); the absence of even a vestigial remnant of this structure tends to argue in favour of the latter.

Using chemical data, Daniels and Sabris (1990) also indicated a paraphyletic evolution for the group, and even went so far as to suggest that the subfamilies Apocynoideae and Periplocoideae be sunk into one family, separate from the other taxa of the suborder.

Although a possibility, the monophyletic nature of the taxa making up the Apocynineae has yet to be convincingly established. However, in the meantime, at the level of suborder and family, the classification of Rosatti (1989a, 1989b) must remain the definitive treatment for these groups; see also Bramwell (Asclepiadaceae) (1978) and Wilkinson (Apocynaceae) (1978). Interestingly, serological data (Lee & Fairbrothers, 1978) suggests that the Rubiaceae is more closely related to the Asclepiadaceae than Apocynaceae. This could not be possible if non-reticulate, monophyletic evolution from the Apocynaceae to Asclepiadaceae took place.

One practical reason for maintaining the Apocynaceae and Asclepiadaceae as separate is that they are family concepts which seem to be easily learned and effectively used in communicating meaningful information, particularly by students

and non-taxonomic botanists. In fact, Robert Brown (1810), in establishing the family Asclepiadaceae, attributed his decision to personal observations he made of this family and the Apocynaceae while he was in Australia and not to extant literature. Possibly the two families are seldom confused because members of the Periplocoideae and Secamonoideae and advanced members of the Apocynaceae are not often encountered in either the field or the laboratory. As a result, many botanists seldom query the incongruencies that macrosystematists see (albeit purely emotional reasons should not be used for keeping these two families separate).

Lastly, it should be mentioned that, in contrast to the general consensus, Cronquist (1981) placed the Plocospermataceae (without rank) in the Apocynaceae and not the Loganiaceae. He gave no reasons for doing so but possibly followed the reasoning given by Hutchinson (1969): There is some merit in this, as can be seen in Figure 3. The consensus is that the Apocyninae consists of two closely related families, the Apocynaceae and Asclepiadaceae, the latter including the Periplocaceae as the subfamily Periplocoideae.

a. Apocynaceae

de Jussieu as Apocineae, *Gen. pl.* 143. 1789. *nom. conserv.*

Type genus: *Apocynum* L.

Apocynaceae: Lindley, 1867: 599–601; Gray, 1878: 392 –394; Bentham, 1876: 681–728; Schumann, 1895: 40–70; Bessey, 1915: 144; Wettstein, 1935: 924–927; Melchior, 1964: 411–414; Rendle, 1967: 468–474; Hutchinson, 1969: 425–430; Swift, 1974: 304–305; Wilkinson, 1978: 224–225; Benson, 1979: 263–265; Cronquist, 1981: 876–879; Goldberg, 1986: 264; Airy Shaw, 1985: 80–81.

Synonyms: Emeticaceae Dulac, *nom. illegit.* **Plocospermataceae** *sensu* Cronquist, 1981: 878. **Plumeriaceae** Horaninow. **Vincaceae** S. F. Gray. **Willughbeiaceae** J. G. Agardh.

Description: *Taxonomic statistics*: approximately 170 genera with about 1800 species. *Distribution*: global, but mainly pantropical. *Habit*: herbs, shrubs, or small to large trees, occasionally lianas or rheophytes, rarely succulent (*Adenium*). *Anatomy*: internal phloem almost always present either as a continuous ring or as isolated bundles on the pith margin; vascular bundles bicollateral; pericycle often with continuous ring or separate strands of white cellulose fibers; well-developed system of non-articulated, branched or unbranched laticifers. *Leaves* opposite or occasionally verticillate (mainly ternifolious), rarely in a pseudospiral due to internode reduction (*Pachypodium*) or alternate; simple and entire; usually without stipules or rarely with small, interpetiolar stipules; colleters common. *Stems* sometimes with anomalous internal and external structure (especially lianas); some genera with spines (*Pachypodium, Carissa*). *Inflorescence* solitary, cymose (including dichasia and cymose-panicle) or racemose; bracts and bracteoles usually present. *Flowers* usually showy, bisexual and actinomorphic or nearly so. *Calyx* (4–)5-merous; free or synsepalous; imbricate or quincuncial; tube often glandular inside or with glandular scales within. *Corolla* (4–)5-merous, sympetalous, usually funneliform or salverform, actinomorphic or nearly so, convolute or rarely imbricate or valvate, sometimes with free or connate coronal appendages within; petals occasionally asymmetrical or lobes extended into very long appendages (*Strophanthus*). *Androecium*: stamens (4–) 5, isomerous, alternipetalous, adnate to corolla tube: filaments occasionally subsessile (some *Carissa* species): anthers free or connivent around style-head; tetrasporangiate or with sporan-

gia restricted to the distal portion of the anther with empty basal portion; usually dithecal; dehiscing via longitudinal slits; often with sagittate basal appendages or connective large and often extended into an appendage (*Adenium*): pollen in monads or tetrads, sometimes these loosely cohering. *Gynoecium* 2 (–8), these connate to varying degrees or apocarpous but united into a common, often specialized, style-stigma head, superior or rarely semi-inferior (*Epigynum* and others); often subtended by a ring of hairs; usually as many locules as carpels although in some genera unilocular with intruding parietal placentation or if bilocular then with axile placentation: style simple or apically bilobed or fused into a style-stigma head: stigma simple or densely penicillate-plumose (*Vinca*): ovules 2 to many in each ovary; commonly pendulous; amphitropous, anatropous, or hemitropous. *Fruit* usually a capsule or follicle, occasionally a berry, drupe, or schizocarp. *Seeds* sometimes comose, winged or arillate (*Tabernaemontana*). *Chemistry*: family producing latex, diverse iridoids, cardioglycosides, and various alkaloids (notably indole and steroid groups), sometimes cyanogenic, rarely saponiferous. *Chromosome number*: $n = 8–12$, rarely polyploid. *Economics*: source of rubber (*Mascarenhasia*), latex (*Landolphia*), drugs such as cardioglycosides (*Acokanthera*), ouabin, and cymarin (*Strophanthus*), and the alkaloids reserpine and rescinnamine (*Rauvolfia*); many genera are of horticultural importance, some of these now being widespread such as oleander (*Nerium*) and frangipani (*Plumeria*).

b. Asclepiadaceae

R. Brown as Asclepiadeae, *Mem. Wern. Nat. Hist. Soc.* **1**: 12–78. 1810. *nom. conserv.*

Type genus: *Asclepias* L.

Asclepiadaceae: Lindley, 1867; 623–627; Bentham, 1876: 728–785; Gray, 1878: 394–400; Schumann, 1895: 40–70; Bessey, 1915: 144; Wettstein, 1935: 927–930; Melchior, 1964: 414–417; Rendle, 1967: 474–478; Hutchinson, 1969: 430–432; Swift, 1974: 305–306; Bramwell, 1978: 225–226; Benson, 1979: 265; Dyer, 1980: 1–90; Cronquist, 1981: 879–882; Goldberg, 1986: 264–266; Airy Shaw, 1985: 98–99; Rosatti, 1989a: 307–401; Rosatti, 1989b: 443–514.

Synonym: Periplocaceae Schlechter. Schlechter, 1905: 351; Bullock, 1956: 503–522; Hutchinson, 1969: 430–431; Airy Shaw, 1985: 874.

Description: *Taxonomic statistics*: approximately 315 genera with about 2200 species. *Distribution*: global, especially pantropical and in warmer temperate regions; the Periplocoideae is confined to the old world and is especially common in tropical Africa. *Habit*: usually herbs [including climbers (*Ceropegia*) and epiphytes (*Hoya*)], occasionally erect shrubs or shrublike trees (*Calotropis*), lianas (*Secamone*), or succulents (*Stapelia*), rarely rheophytic (*Kanahia*). *Anatomy*: well-developed, extensive system of non-articulated, branched or unbranched laticifers; stems often with anomalous structure (*Secamone*); internal intraxylary phloem always present either as a continuous ring or as isolated strands at the margin of the pith; pericycle generally containing some cellulosic fibers. *Underground organs* fibrous (*Gomphocarpus*), long woody caudex (*Pachycarpus*) or swollen tuber (*Raphionacme*). *Leaves* usually opposite, sometimes verticillate or triternate, rarely alternate, usually simple and entire, rarely lobed (*Emicocarpus*) or toothed, sometimes absent (especially in succulent species), occasionally forming a pitcher-like structure that stores water and provides homes for ants (*Dischidia*); without stipules but often with an interpetiolar

line; colleters common. *Stems*: occasionally leafless and succulent and/or with short spines (*Hoodia*). *Inflorescence* terminal or nodal, usually umbelliform (but not in the Periplocoideae) or cymose, seldom racemose. *Flowers* often showy; bisexual or rarely functionally unisexual; actinomorphic or nearly so; some flowers sweetly scented others (mainly succulent genera) foetid, smelling like carrion; pollination: highly specialized for and obligated to insect pollination (mainly Diptera, Hymenoptera, and Lepidoptera). *Calyx* 5-merous; imbricate or valvate; occasionally shortly connate. *Corolla* 5-merous; convolute or seldom imbricate or valvate; either rotate with lobes erect, spreading or reflexed; rarely lobe tips connate or produced into a canopy (*Ceropegia*), or lobes connate forming a short to long tube (*Microloma*), lobes occasionally with small basal corona (*Glossonema*) or with thickened annulus surrounding the gynostegium (*Orbea*); glabrous (*Aspidonepsis*) to densely hairy (*Sisyranthus*) or papillate (*Huernia*); in some succulent genera the lobes may be fleshy and resemble dead animal skin or hide. *Androecium*: stamens 5, isomerous and alternipetalous: filaments usually adnate on corolla tube near its base or distinct in Periplocoideae; these usually cornified along their lateral margins into anther-wings; base usually with or sometimes without (*Astephanus*) a corona: staminal coronas may be simple (*Xysmalobium*) to ornate or complex with various appendages (*Miraglossum*), large to small and usually nectariferous; anthers basifixed, introrse, dithecal, bisporangiate (Asclepiadoideae), or tetrasporangiate (Periplocoideae and Secamonoideae); dehiscing longitudinally or apically; connate into a staminal curtain surrounding gynoecium and adnate to the style-stigma head (or connivent in Periplocoideae) forming with the gynoecium a central column called the gynostegium; connective often elongated into an membranous apical appendage: translator apparatus produced, but differing substantially in the Periplocoideae, Secamonoideae, and Asclepiadoideae, usually consisting of a gland or corpusculum to which are attached 2 translator arms or caudicles, at the end of which is a spoonlike receptacle (Periplocoideae), four pollinia (Secamonoideae), or two pollinia (Asclepiadoideae), the entire structure being called a pollinarium; in Secamonoideae and Asclepiadoideae the translator apparatus connects pollinia from adjacent anthers: pollen in tetrads; in Periplocoideae these being loosely coherent and transported on a spoon-shaped translator; in Secamonoideae and Asclepiadoideae tetrads coalesce into waxy structures called pollinia. *Gynoecium* without nectariferous disk; bicarpellate; apocarpous; superior or rarely semi-inferior (*Atherandra*); unilocular: ovules usually many, rarely reduced to as few as 1; placentation marginal or pendulous; anatropous, unitegmic and pseudocrassinucellar; with or without an integumentary tapetum: style bases free but united apically into a style-stigma head: stigma reduced to 5 discrete regions on the style-stigma head (except in *Secamone*) and situated below the stigmatic chamber which is formed by two adjacent and appressed (but not fused) anther-wings. *Fruit*: 2 free follicles (*Brachystelma*) or often 1 by abortion (*Xysmalobium*); may be inflated and/or echinate (*Gomphocarpus*). *Seeds* flattened with a terminal coma. *Chemistry*: family producing latex, cardioglycosides, alkaloids (of the indole, pyridine and phenanthro-indolizidine types), rarely cyanogenic and saponiferous, noted for lacking iridoids. *Chromosome number*: $n = 9$–12. *Economics*: some are a potential source of fiber and down (*Asclepias*), but their main economic value is as horticultural plants (in particular *Hoya*, *Ceropegia*, and many of the succulent species); a few are troublesome weeds along roadsides (*Gomphocarpus*) or in ploughed farm lands (*Asclepias*).

4. Excluded Families

a. Buddlejaceae Wilhelm (*nom. conserv.*)

As discussed under the Loganiaceae, this family is now considered allied to the Scrophulariaceae, falling within the Scrophulariales (Cronquist, 1988; Dahlgren, 1983; Goldberg, 1986; Takhtajan, 1983; Wagenitz, 1977) or Bignoniales (Thorne, 1992).

Its relationship to the Scrophulariaceae and Retziaceae is apparently also supported by embryological evidence (Engell, 1987). Data suggest that this taxon may form a bridge between the Gentianales and Scrophulariales (Figs. 3 & 4). Of particular note is the lack of intraxylary phloem and of colleters, both typically found in the Gentianales. The family Buddlejaceae consists of 7 or 8 genera (depending on authority) with about 50 species. These are mainly trees or shrubs. They are distributed in tropical and subtropical regions (*Buddleja* L. being a weed introduced into Europe).

b. Carlemanniaceae Airy Shaw

According to Brummitt (1992), Takhtajan (1987) included this family in the Gentianales. This Russian work, not having been accessible, has unfortunately had to be omitted from our consensus. The reason for Takhtajan's decision is thus unknown to us. For completeness, however, it was thought that some mention should be made of the family.

Hooker (1873) and de Dalla Torre & Harms (1900–1907) included the two involved genera (viz. *Silvianthus* Hooker *f.* and *Carlemannia* Bentham) in the Rubiaceae [Hooker (1873), under the Hedyotideae]. Cronquist (1981), Hutchinson (1969), Melchior (1964), and Takhtajan (1969, 1980, 1983) included these genera under the Caprifoliaceae. In 1980, Takhtajan gave it subfamily status under the Caprifoliaceae, then in 1987 he seems to have transferred it, at family rank, to the Gentianales. However, he has been the only authority to have done this. Dahlgren (1983) and Thorne (1992) make no mention of this taxon.

Airy Shaw (1965), when proposing the family Carlemanniaceae, favoured links to the Verbenaceae (via *Silvianthus*) and to the Gesneriaceae (via *Carlemannia*). However, in 1985, Airy Shaw seems to have changed his mind on this and suggested that, for *Carlemannia* at least, there is more affinity with the genus *Cardiandra* Sieber & Zuccarini in the Hydrangeaceae than with the Gesneriaceae. It is interesting to note how often the Hydrangeales *sensu* Thorne or Cornales *sensu* Dahlgren is mentioned in the literature when the affinities of many groups of Asteridae are examined.

Current consensus is that the Carlemanniaceae be included under the Caprifoliaceae and not as separate or synonymous family within the Gentianales. The taxon consists of two genera with five species, all herbs or subshrubs distributed from Southeast Asia to Sumatra.

c. Columelliaceae D. Don

This monotypic family was included in the Gentianales by Goldberg (1986), but he gave no reasons for doing so. His ideas do not seem to have been followed by other modern workers. Benson (1979), Morley (1978), Stebbins with reservations (1974), and Takhtajan (1969) placed this family in the Scrophulariales which is in the Asteridae *sensu* Cronquist. However, Wagenitz (1977) indicates that the Col-

umelliaceae seems to be aberrant within this subclass. Most workers now seem to concur with this, and Takhtajan (1983) transferred the Columelliaceae to his Saxifragales, suborder Pittosporineae. Originally, Thorne (1976, 1983) seemed to follow this line of thought and included the taxon under the Saxifragaceae as the subfamily Columellioideae, the Saxifragaceae falling under Thorne's suborder Saxifragineae in the Rosales. Then, in 1992, Thorne seems to have changed his mind and placed the Columelliaceae in his Hydrangeales next to the family Desfontainiaceae (the latter usually placed in the Loganiaceae), this particular arrangement being more congruous with presently available data than his past classifications. Dahlgren (1980, 1983) included the Columelliaceae in his Cornales (which includes the Hydrangeaceae and allies). Cronquist (1968, 1981), although including it in his Rosales (and not his Saxifragaceae), did so as a family in its own right. In total contrast, Hutchinson (1969) included the Columelliaceae under the family Euphorbiaceae, an idea not receiving much support. Consensus is that this family should not be included in the Gentianales. Data suggest that, along with the Desfontainiaceae, this family is a bridging taxon between the Cornales/Hydrangeales and Gentianales (Fig. 4). The genus *Columellia* Ruiz & Pavón contains four species, all evergreen shrubs restricted to the continent of South America.

d. Convolvulaceae A.L. de Jussieu

This family was included in the Gentianales by Goldberg (1986), but he gave no reasons for doing so. His ideas do not seem to have been followed by modern workers, although computational analysis by Young and Watson (1970) suggests an association of this family with their asclepioids (very roughly equal to the Gentianales). Dahlgren (1980, 1983) and Hutchinson (1969) placed this family in the Solanales, as did Thorne (1976, 1983, 1992), who went on to place this family in the suborder Solanineae.

Benson (1959), Stace (1978), Stebbins with reservations (1974), and Takhtajan (1969) placed the Convolvulaceae in the Polemoniales. In 1980, Takhtajan retained this family in the Polemoniales but this time under the suborder Convolvulineae, a system he continued to follow in 1983.

Opinions thus seem split between placing this family in either the Solanales or Polemoniales. In fact, in 1968 Cronquist placed the Convolvulaceae in the Polemoniales but later (Cronquist, 1981) transferred it to the Solanales. However, this confusion between the Polemoniales and Solanales may be due to historic considerations and a lack of nomenclatural consensus rather than to purely taxonomic considerations. The consensus is that the Convolvulaceae be excluded from the Gentianales. Data suggest a connection with the Solanaceae and its allies. The family consists of about 55 genera comprising approximately 1750 species, most of which are herbs or climbers, rarely trees (e.g., *Humbertia*). It has a global distribution.

e. Cuscutaceae Dumortier

This family was included in the Gentianales by Goldberg (1986), but he gave no reasons for doing so. His ideas have not been followed by other modern authorities. Many older workers sank this family under the Convolvulaceae (e.g., Bessey, 1915); however, almost all modern workers retain the Cuscutaceae as a separate but closely related family (Cronquist, 1988; Dahlgren, 1983; Takhtajan, 1983), the two modern exceptions being Brummitt (1992) and Thorne (1983, 1992), who treat the taxon as a

subfamily, the Cuscutoideae, under the Convolvulaceae. As a result, the ordinal classification of the Cuscutaceae mirrors that of the Convolvulaceae. The one major exception to this is Hutchinson (1969), who included the Convolvulaceae in the Solanales and the Cuscutaceae in the Polemoniales; see discussion on the Polemoniales versus the Solanales under the Convolvulaceae. The consensus is that this family should not be included in the Gentianales. Data suggest that this family is closely allied to the Convolvulaceae, which has affinities with the Solanales. The Cuscutaceae is monotypic, the genus *Cuscuta* L. consisting of about 170 species, all of which are leafless, rootless, herbaceous parasites. They are distributed globally.

f. Dialypetalanthaceae Rizzini & Occhionii

Cronquist (1968, 1981) and Hutchinson (1969) placed the Dialypetalanthaceae near the Rubiaceae; however, Cronquist (1988) later removed this family from the Gentianales and placed it in his Rosales. Dahlgren (1980) placed the Dialypetalanthaceae in his Cornales but later (Dahlgren, 1983) transferred it to the Gentianales near the Rubiaceae. Goldberg (1986) and Stebbins (1974) suggested that the family be placed in the order Myrtales. Heywood (1978a) and Thorne (1976, 1992) appear to make no mention of the family, although in 1983 Thorne had included it as a separate family in the Gentianales, a stand also taken by Takhtajan (1983). Present consensus seems to be that this family is not part of the Gentianales. The major anomalous feature of the Dialypetalanthaceae is the large number of stamens possessed by the family: 16–25 in two whorls. This character does not fit well with Gentianalian floral morphology in particular, and with the Cornales/Hydrangeales to a lesser extent. However, available data seem to infer that a prehistoric mass of proto-Rosales–Saxifragales–Cornales-like taxa (possibly not separable into units as large as families or orders at that time?) gave rise to the present-day Gentianales and Myrtales (amongst others). The condition of numerous stamens is at home within the Myrtales. The fact that the Dialypetalanthaceae shows characteristics found in the Myrtales, Cornales, and Gentianales suggests that the Dialypetalanthaceae may represent a particularly archaic and somewhat isolated group (all its closest relatives now being extinct) with connections to all three of these modern orders. If this family does form a living-fossil group, as its morphology suggests, then it deserves much closer scrutiny and analysis than it has received to date. Consensus, with which these authors agree, suggests that the Dialypetalanthaceae should not be sunk under the Rubiaceae. Data would suggest a place near the Cornales and allies. The monotypic/monospecific Dialypetalanthaceae (*Dialypetalanthus fuscescens* Kuhlmann) is a tree restricted to tropical eastern Brazil.

g. Menyanthaceae (Dumortier) Dumortier

There is between 45% and 61% agreement for including this family in the Gentianales depending on the authorities consulted since 1960. Dahlgren (1983), Wagenitz (1977), and others support the inclusion of this family in the Gentianales with which it has, in the past, been placed as a tribe (Bentham, 1876) and as a subfamily (Gilg, 1895). However, Thorne (1976, 1983), having placed it in the Gentianales, went on to suggest its inclusion in the Campanulales but did not give reasons for doing so (Thorne, 1992). Cronquist (1981) argued for its inclusion in the Solanales. Cook (1978) placed the Menyanthaceae in the Polemoniales (which in this classification also includes the Solanaceae). According to G. Dahlgren (1989), shortly before his death R. Dahlgren transferred the Menyanthaceae to his Cornanae. These differing

opinions are probably due to the way seemingly conflicting data available for this family is interpreted. It is also interesting that consensus is split almost equally for and against inclusion; see also Airy Shaw (1985), Brummitt (1992), and Takhtajan (1983). However, presently available anatomical, embryological, and chemical data make it anomalous in the Gentianales (Fig. 3), and it is suggested that the Menyanthaceae be excluded from this order until further data on this taxon is gathered to help place it more exactly. Interestingly, consensus is that the Menyanthaceae does fit well into the Asteridae. The family consists of five genera with about 40 species (33 according to Airy Shaw, 1985). Most are aquatic or marshy herbs. The family is distributed globally but is found primarily in temperate regions of both hemispheres and in tropical Southeast Asia.

h. Oleaceae Hoffmansegg & Link

Heywood (1978a) and Stebbins with reservations (1974), agreeing with historical consensus, continued to place this family in the Gentianales. Hutchinson (1969), in a similar vein, placed the family in his Loganiales. Cronquist (1981, 1988), breaking with tradition, placed the Oleaceae in his Scrophulariales but admitted that it may form a possible link between this order and the Gentianales. In 1969 Takhtajan placed the family in its own monotypic order, the Oleales, and suggested that it was related to the Celastrales; then, in 1980, he changed his mind, suggesting an affinity to the Gentianales. Some workers have retained the order Oleales (Goldberg, 1986) but have questioned its affinities. Wagenitz (1977) suggested that the order Oleales be maintained but placed near the Gentianales rather than the Celastrales or Scrophulariales. Following this line of thought, Dahlgren (1980, 1983) kept the monotypic Oleales separate but placed them in his Gentianiflorae. Interestingly, Thorne (1976) placed the Oleales (which also contained the Salvadoraceae) in his superorder Santaliflorae; later he placed the order in the superorder Gentianiflorae (Thorne, 1983), and finally, in 1992, he dissolved the order Oleales and placed the family Oleaceae in his Bignoniales under the suborder Bignonineae (along with Buddlejaceae and the Retzioideae: Stilbaceae). Unfortunately, Thorne gave no reasons for changing his mind, but his 1992 classification does accord more with that of Cronquist (1988) and existing morphological and chemical data. Young and Watson's (1970) computational analysis places the Oleaceae (as well as Solanaceae) midway between their asclepioids (= ± Gentianales) and acanthoids (= ± Bignoniales *sensu* Thorne, 1992 or Lamiiflorae *sensu* Dahlgren).

It can be seen from the above discussion that the exact relationships and rank of this taxon is still much disputed. Consensus seems to be that it be placed near the Gentianales, in either the Scrophulariales or Bignoniales or somewhere in between, and that it not fall within the Gentianales itself. Certain data suggest that the Oleaceae may be an archaic bridging taxon between the Gentianales and Scrophulariaceae and allies. The family, consisting of about 25 genera with ca. 600 species, is distributed globally but found particularly in pantemperate regions and tropical Asia. The family consists of trees, shrubs, and climbers.

i. Retziaceae Bartling

This taxon has had a complex and much-debated history. The rank at which it has been recognized has ranged from tribe (Retzieae) to subfamily (Retzioideae) to family (Retziaceae). By tradition, this taxon has been considered as falling under the Loganiaceae; however, in 1969 Hutchinson gave it family status and placed it in his

Solanales. These ideas were followed by Cronquist (1988). Dahlgren et al. (1979), however, suggested an association with the Stilbaceae in his Scrophulariales, a proposal supported later by embryological datum (Engell, 1987). Thorne (1992) followed Dahlgren and co-workers' line of thought but reduced this taxon to the rank of subfamily, the Retzioideae, under the family Stilbaceae in his Bignoniales. Takhtajan (1983) placed this family in the Scrophulariales near the Scrophulariaceae. Although its exact placement is still not agreed upon, consensus is that the Retziaceae should not be placed within the Gentianales. The monotypic/monospecific Retziaceae (*Retzia capensis* Thunberg) is a shrub confined to the heathlands or fynbos of the southwestern Cape of South Africa.

j. Salvadoraceae Lindley

Although traditionally placed with the Oleaceae in the Gentianales (Bentham, 1876; Knoblauch, 1892), the exact position of the Salvadoraceae in the dicotyledons remains in debate. Goldberg (1986) placed the family (with the Oleaceae) in the order Oleales. In 1976 Thorne, using the Oleales (as circumscribed in the same way as Goldberg (1986)), placed the order in his superorder Santaliflorae, then in 1983 he transferred the order to the superorder Gentianiflorae. Finally, in 1992, Thorne placed the Salvadoraceae in his *Incertae Sedis* appendix (i.e., taxa of uncertain position). Dahlgren (1980, 1983) placed the family in the monotypic order Salvadorales in his Violiflorae but did mention its position as being uncertain. Chant, with doubts (1978), Hutchinson (1969), Stebbins (1974), and Takhtajan (1969, 1983) all placed the Salvadoraceae in the Celastrales, possibly following Wettstein (1935). Consensus is that the Salvadoraceae is in no way related to, nor should it be included with, the Gentianales. Airy Shaw (1985) suggested a possible relationship with the Avicenniaceae. Of all the taxa dealt with in this paper, the position of the Salvadoraceae remains the most mysterious. The family consists of 3 genera with approximately 12 species. Distributed in the Old World tropics and subtropics, they are often found in hot, dry regions or associated with coastal saline areas and are usually small trees, shrubs, scramblers, or occasionally spiny (e.g., *Azima* Lamarck).

VIII. Conclusion

A consensus classificatory model for the Gentianales is given. The degree of consensus regarding the family composition of the order is high, but the relationships of the taxa within the order are still open to debate, especially where subfamilies and tribes are concerned. The Loganiaceae, in particular, proves problematic in terms of a consensus concerning its tribal circumscription. Within the suborder Apocyninae, the monophyly of the taxa concerned has not been conclusively established by past workers. If these taxa prove to be paraphyletic, it could alter present family and subfamily concepts within the suborder.

A comprehensive cladistic study of the order Gentianales (including the Rubiaceae) to the level of subfamily, or even tribe, would at this time prove extremely useful to any further debate concerning classification within the order. The relationship of the families of the Gentianales to the rest of the subclass Asteridae (particularly the Scrophulariales and Solanales), as well as to the Dipsacales, Myrtales, and Cornales and allies, also needs to be explored more rigorously.

We believe the consensus model given in this paper will be a useful teaching aid.

The model also highlights areas where further research is desirable, especially while associated species are not yet extinct in the wild. We also hope the model given here is more predictive than its predecessors and that the consensus technique will be applied to less well-circumscribed orders in the hope of increasing their usefulness.

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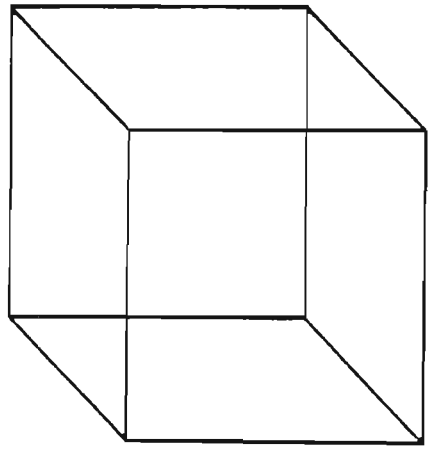
CHAPTER 4

TAXONOMY

of the Asclepiadinae in Southern Africa

As pointed out by Cronquist (1988*) the search for morphological and evolutionary patterns can be a bit like the Necker Cube below - constantly changing perspective just when we think we've got it.



CONTENTS

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* CRONQUIST, A. 1988. **The Evolution and Classification of the Flowering Plants.** 2nd edn. New York, The New York Botanical Garden

KEY TO THE GENERA OF THE SUBTRIBE ASCLEPIADINIAE IN SOUTHERN AFRICA

Please note that this key may only work for these genera as they occur in southern African.

[1] Chapter 4.2 [2] Chapter 4.3 [3] Chapter 4.4

1a Corona-lobes cupulate; with a distinct corona-lobe sinus 2
1b Corona-lobe lobulate, lacimiform or laminate; without a corona-lobe sinus .. 17

2a Plants with stems decumbent or prostrate along the ground 3
2b Plants with stems erect 4

3a Leaves ±ovate, often as wide as broad. Corona-lobes saccate or slipper-shaped, usually longer than tall. Anther-wings without a distinct notch along its length ..... *Pachyacris*[1]
3b Leaves more or less linear, longer than broad. Corona-lobes turriform always taller than long. Anther-wings with a distinct notch somewhere along its length ..... *Bruynsia*[1]

4a Inflorescences racemose elongating indefinitely ..... *Kanahia*[2]
4b Inflorescences umbel-like, not elongating indefinitely 5

5a Corona-lobe turriform. Anther-wings with a distinct notch somewhere along its length ..... *Bruynsia*[1]
5a Corona-lobe not turriform. Anther-wings smooth & straight, without a notch 6

6a Corona-lobe with a sinus appendage 7
6b Corona-lobe without a sinus appendage 9

7a Plants almost shrubby, stems when mature ±800mm or more tall. Corona-lobe sinus appendage horn-shaped. Plants introduced from the Americas ..... *Asclepias*[1]

7b Plants herbaceous. Stems if one then erect and 800mm, if more than one stem then only 200mm long and decumbent. Corona-lobe sinus appendage tongue-shaped. Plants not of African origin 8

8a Stems usually one (rarely 3 in *A. flava*), erect. Rootstock an ovoid stem-tuber ..... *Aspidonepsis*[1]

8b Stems usually as many as five or more (seldom one) and procumbent. Rootstock a deep-seated cylindrical stem-tuber ..... *Bruynsia*[1]

9a Flowers large, 20mm to 70mm in diameter 10

9b Flowers small, 5mm to 15mm in diameter 11

10a Leaves various with margins always flat. Fruits ovoid to globose, surface winged or winged & echinate ..... *Pachycarpus*[2]

10b Leaves linear with margins always revolute. Fruit fusiform, surface smooth ..... *Trichocodon*[2]

11a Peduncle more than 100 to 140mm long 12

11b Peduncle less than 95mm long 13

12a Stems thin & wiry from base. Leaves narrowly linear, 0.3 to 5.0mm wide. Flowers yellow. Follicles smooth ..... *Aidomene*[1]

12b Stems thick at the base. Leaves broadly linear to lanceolate, 5 to 22mm wide. Flowers pink or pinkish green. Follicles rugose to almost echinate ..... *Pachyacris*[1]

13a Corolla white, pinkish white or yellowish white 14

13b Corolla yellow, yellow & brown, purple, green or purplish green 15

14a Plants with a single erect stem throughout ..... *Paulforstera*[1]

14b Plants always branched, sometimes even fruticose ..... *Gomphocarpus*[1]

15a Plants with a single, erect stem. Flowers yellow or yellow & brown. Rootstock a globose stem-tuber ..... *Aspidonepsis*[1]

15b Plants with a number of stems, if one stem then flowers purple, green or purple-green. Rootstock a deep-seated cylindrical or carrot-shaped stem-tuber 16

16a Leaves broadly rounded to slightly cordate at the base, margins often crispate. Corona arising at 1mm above corolla, subquadrangular with a shallow and narrow central fissure. Fruits with 4 small wings ..... *Sigridia*[1]

16b Leaves tapering at the base, margins never crispate. Corona arising at the corolla base, slipper-shaped with a large central sinus. Fruit smooth ..... *Aidomene*[1]

17a Plants rheophytic; inflorescences racemose & elongating indefinitely ..... *Kanahia*[2]

17a Plants not rheophytic; inflorescences umbel-like, not elongating indefinitely 18

18a Style-apex club-like or trumpet-shaped, exerted way beyond the anther-appendages 19

18b Style-apex never club- or trumpet-like, if extended beyond the anther-appendages then only slightly so 20

19a Style-apex club-like; leaves linear, 0.7 to 3.5mm wide ..... *Cordylogyne*[2]

19b Style-apex trumpet-like; leaves never linear, 10 to 80mm wide ..... *Xysmalobium*[2]

20a Inflorescences sessile 21

20b Inflorescences pedunculate 24

21a Corona-lobes lobular, without appendages, horns or prominent teeth. Fruits ovoid or subglobose, surface winged or toothed ..... *Pachycarpus*[2]

21b Corona-lobes laminar, with appendages, horns or prominent teeth. Fruits fusiform, surface smooth 22

22a Corona-lobes fleshy, not distinctly dorso-ventrally flattened (about as broad as wide ..... *Miraglossum*[2]
22b Corona-lobes laminar, dorso-ventrally flattened (broader than wide) 23

23a Petals erect & distinctly revolute ..... *Schizoglossum*[2]
23b Petals reflexed, spreading or erect, if erect then not revolute ..... *Aspidoglossum*[2]

24a Leaves always linear with margins distinctly revolute 25
24b Leaves various with margins not revolute 31

25a Corona-lobes deeply divided into a larger middle lobe with 2 marginally smaller lateral sublobes ..... *Woodia*[2]
25b Corona-lobes entire & not deeply subdivided 26

26a Corona-lobes exerted well beyond the erect corolla tube & curled at the tips ..... *Stenostelma*[2]
26b Corona-lobes not exerted beyond the corolla if it is erect, or corolla spreading to reflexed 27

27a Corona-lobes slipper-shaped & horizontal, with large paired wings on the inner upper surface ..... *Trichocodon*[2]
27b Corona-lobes ligulate, scale-like, tear-drop shaped, cucullate & erect 28

28a All, or at least some, leaves undulate ..... *Woodia*[2]
28b All leaves smooth & flat, never undulate 29

29a Leaves much longer than the internodes; petals spreading-reflexed to reflexed ..... *Stenostelma*[2]
29b Leaves about as long as or shorter than the internodes; petals erect or spreading erect 30

30a Corona-lobes cucullate; translator-arms long sinuous & winged ..... *Stathmostelma*[2]

30b Corona-lobes ligulate or sagittately cordate; translator-arms short & simple ..... *Periglossum*[2]

31a Corona-lobes deeply divided into a larger middle lobe with 2 smaller lateral sublobes ..... *Woodia*[2]

31b Corona-lobes entire & not subdivided, but sometimes with appendages 32

32a Staminal-corona connate to the corolla tube mouth ..... *Parapodium*[2]

32b Staminal-corona free from the corolla 33

33a Inside of corolla with argyrocomous hairs ..... *Xysmalobium*[2]

33b Inside of corolla if hairy then hairs not argyrocomous 34

34a Corona-lobes slipper-like, distinctly horizontal from the base, but often erect near the apex, with broad wings ..... *Pachycarpus*[2]

34b Corona-lobes ligulate or scale-like, erect from the base, entire & simple or with thin horn-like appendages 35

35a Petals 9 to 14mm wide; corona-lobes globular or slightly laterally compressed ..... *Pachycarpus*[2]

35b Petals 1.5 to 8mm wide, corona-lobes scale-like & dorso-ventrally compressed 36

36a Corona-lobes laminar, dorso-ventrally flattened, usually with horn-like or dentate appendages, rarely simple & entire ..... *Schizoglossum*[3]

36b Corona-lobes fleshy, always simple & entire 37

37a Stems 300 to 1300mm tall; pedicels 9.5 to 25.0mm long; petals 5.5 to 12.5mm long, 3 to 8mm wide; corona-lobes suborbicular ..... *Pachycarpus*[2]

37b Stems 150 to 300mm tall; pedicels 5 to 9mm long; petals 3.75 to 5.5mm long, 1.7 to 3.0mm wide; corona-lobes obovate or subquadrate ..... *Woodia*[2]

CHAPTER 4.2

A REASSESSMENT OF THE GENUS *ASCLEPIAS* (APOCYNACEAE: ASCLEPIADOIDEAE) IN SOUTHERN AFRICA

Schlechter (1895) on his uniting of *Asclepias* and *Gomphocarpus* "I must confess that I have tried to avoid the union of two such well-known and large genera, but I fail to see the slightest reason for keeping them any longer separate. I therefore propose, although against my own inclination, to unite them now, for a union is unavoidable.."

CONTENTS

A REASSESSMENT OF THE GENUS *ASCLEPIAS* L. (APOCYNACEAE: ASCLEPIADOIDEAE) IN SOUTHERN AFRICA

A. Nicholas*, H. Baijnath* & D.J. Goyder**

Abstract

The genus *Asclepias* is here considered to be a New World taxon only, occurring in southern Africa as an adventive only. Species previously placed in this genus are partitioned of into already extant genera (*Aidomene, Aspidonepsis, Gomphocarpus*, and *Pachycarpus*) and newly described genera (*Bruynsia, Pachyacris, Paulforstera* & *Sigridia*). A new species of *Gomphocarpus*, *G. otiocephalus*, is also described.

Introduction

Evidence that has accumulated over the last forty years suggests that those species in the genus *Asclepias* L. occurring on the African continent have a different origin to the *Asclepias* species of the Americas (Bullock 1952 to 1963, Nicholas 1981). *Asclepias physocarpa* E. Mey. and allies (= *Gomphocarpus* R.Br.) and the sister genus *Kanahia* R. Br. appear to have evolved from a common ancestor (paper in preparation), while *Asclepias diploglossa* (Turcz.) Druce and allies (= *Aspidonepsis* Nicholas & Goyder) seem to have evolved from a common ancestor with *Aspidoglossum* E. Mey. (Nicholas & Goyder, 1992). The evolutionary paternity of American *Asclepias* species still remains obscure. If they share a common origin with any of the African groups of the Asclepiadinae, then this connection is probably ancient and not directly with *Kanahia, Aspidoglossum* and immediately adjacent southern African genera. Any connection is more likely to be with the tropical African genus *Margaretta* Oliv. *Margaretta* is widespread in the African tropics, including west Africa and bears many similarities to the American species of *Asclepias*. Such similarities include similar rootstock, vegetative

* Botany Department, University of Durban-Westville, Private Bag 54001, Durban 4000, Natal, South Africa

** The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK.

faces, corona-lobe sinus with a central sinus appendage or 'horn', the same range in flower color (which ranges from pink to red to orange to yellow) and similar follicles with straight pedicels (these latter very like those of *A. curassavica* L.). There are, however, also important differences which set these two genera apart. These differences include the petaloid distal corona-lobe appendage, erect anther-appendages and elongated style-stigma-head in *Margaretta*.

Group Delimitation

In pursuit of phylogenetic groups for the African members of *Asclepias sensu lato*, Bullock (1952 & 1954a) begun to reassign them to other extant genera [e.g. *Pachycarpus* E. Mey.], to genera which he resurrected [e.g. *Stathmostelma* K. Schum.] or to newly described genera [e.g. *Trachycalymma* (K. Schum.) Bullock]. This process was not undertaken for the southern African species because Dyer (1975) considered Bullock's work to be tentative. These reservations are discussed in detail in Nicholas & Goyder (1992). A study undertaken by Nicholas (1981), however, concurred with Bullock's conclusion that *Asclepias* be confined to the Americas; with its presence in Africa being only that of an adventive or invader. Since then, and because the genus *Asclepias sensu lato* is probably polyphyletic (Nicholas 1989), work has proceeded with reassigning the southern African species to their new generic positions (Nicholas & Goyder, 1990 & 1992). Because of demands by other taxonomists, ecologists, conservationist and ethnobotanists for correct names for this large and important southern African family, and because the production and publication of individual revisions for each genus will take sometime, it was felt that a synopsis of this work should be given here, and all relevant new descriptions and combinations made. Unlike artificial groups which can be defined on single characters and, therefore, can also be very large (e.g. all species with a corona-lobes sinus being placed in *Asclepias*), phyletic genera are often more complex to define and usually less specious. This is because evolution tends to result in increasing morphological diversity and not the other way around. See under the genus *Aidomene* subgenus *Scyphocalymma* for further discussion on this subject; this background theory and rationale is necessary to understand how we have delimited groups. In this paper, all those species catalogued under the genus *Asclepias* (Retief, 1987) in the widely used **List**

of Species of Southern African Plants published by the former **Botanical Research Institute** (now the **National Botanical Institute**) are dealt with and assigned to their new positions in the subtribe Asclepiadinae. There has been a long tradition of using Latinized Greek names in the family Asclepiadaceae. We have, because of this, continued with this tradition when naming new taxa.

Conservation

In the 18 years that the senior author has been studying and collecting Asclepiadaceae in South Africa, he has noticed (with few exceptions — except for perhaps *Gomphocarpus fruticosus* and *G. physocarpus*) a distinct decline in species encountered in the wild in both population number and size. This is not surprising given that the population of the country has, doubled in this period from 20 million to about 40 million. This has been accompanied by expanding agricultural, pine and eucalyptus plantations (the so called green deserts), industrialization and urban conurbation. These destructive anthropogenic activities have, in particular, impacted on the grassland biome of the summer rainfall region more than any other and it is in this grassland biome that the vast majority of species in the Asclepiadinae are found. As a result, many of them are either vunerable or even threatened with extinction. In tandem with this increasing exploitation of once wild areas has come increasing pollution (macro- & micro-), acid rain and the over use of pesticides. These have lead to the disruption of the natural system and affected insect populations which the Asclepiadaceae, as primarily obligated allogamous species, rely on for pollination. This decrease in insect pollinators has, in consequence, lead to a decrease in fruit and seed set. It has been well established that population dynamics can be affected by changes in pollinator resources (Ingvarsson & Lundberg, 1995). The situation has, unfortunately, been exacerbated by several consecutive years of *el nino* induced drought, that has led to a ban on the grazing of road reserves being lifted. This has resulted in the destruction of these previous havens of plant diversity and migration corridors. Unfortunately, it is not just mesophytic habitats that have been affect by this increasing degradation but also wetlands. Rivers have been dammed, bled dry for irrigation purposes, sapped up by the indiscriminate planting of pines, eucalypts and sugar cane, and also polluted especially with toxic heavy metals. Eutrophication has, as a result,

become a common phenomenon in many aquatic habitats. This has affected many wetland plants including the few Asclepiadaceae species that grow in this situation. As the conservation of this family is now a matter of concern, and because so many species are already listed on the **southern African red data list** (Hilton-Taylor, 1996), we have tried to give the conservation status of each species dealt with. For species in KwaZulu-Natal we have followed Scott-Shaw's red data book for this province (in press). Elsewhere we have attempted, as best as possible, to allocate conservation status ourselves. This has been done based on the IUCN red list categories as outlined on their website.* In brief these categories are obtained by ascertaining or assessing the following (Scott-Shaw, in press):

① **Species with Declining Populations** — The rate of decline over time, both past and predicted future rates. This decline applies not only to plant and population numbers, but to the range of distribution and habitats as well. It can be assessed using observations and indices of abundace. Of concern here is the actual or potential levels of exploitation and the level of habitat degredation (displacment by introduced weeds, human activities and pollution). For instance if a species has lost 80% of its number in 10 years or three generations then it must be considered Critically Endangered, 50% then Endangered and 20% them Vulnerable.

② **Species with Small Declining or Fluctuating Distribution Ranges** — This includes the assessment of the distribution range (either extent of occurrence or area of occupancy), amount and extent of population fragmentation, and population viability (especially isolated populations). An example here would be a species whose area of occupancy is $<10km^2$ would be considered Critically Endangered, $<500km^2$ is Endangered and $<2000km^2$ is Vulnerable. Also, of concern here is population flutuation.

③ **Species with Small Population Size Accompanied by Continuing Decline** — Required here is the number of reproductively mature individuals. Species with <250 mature individuals must be considered Critically Endangered, <2500 = Endangered and <10 00 = Vulnerable. This is assessed in conjunction with either a rapid decline rate or fragmentation.

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* Websites are cited after the references.

④ **Species with Very Small Population Size & Restricted Distribution** — This involves the calculation of the exact number of reproductively mature individuals and population susceptability. Species with <50 individuals must be considered Critically Endangered, <250 individuals are Endangered and <1000 individuals are Vulnerable.

⑤ **Quantitative Assessment of Extinction in the Wild** — Species that will become 50% extinct in 10 years or three generations must be considered Critically Endangered, 20% in 20 years or five generartions are Endangered and 10% in 100 years are Vulnerable.

Citation of Representative Specimens

In order to fix our species concepts so that they can be easily reassessed by future workers (a prerequist of the empirical method that requires repeatability and accountability) we have cited a limited amount of herbarium specimens. We have tried to enumerate specimens that represent the range of the species concerned and also to cite at least one (if not more) for each of the herbaria consulted. Hopefully, this will make it easier for our species concepts to be understood and checked. Species that are widespread, but not so varied (such as *Gomphocarpus fruticosus*) or very varied but not widespread (such as *Pachyacris meliodora*) tend to have more specimens cited than species of limited variation and distribution (such as *Pachyacris flexuosa*).

Distribution Maps

Beacuse it was important for us to be sure of the accuracy of each quarter degree grid plotted, these maps were compiled from specimens seen by us and of whose identity we where sure. However, many of the populations represented on these maps are now extinct. As a result, they are high informative, but also an illusion in that they represent the historic rather than actual distribution of the taxa involved. For more discussion on this see Nicholas & Baijnath (in press).

KEYS

Keys in this paper have been constructed using data from southern African specimens only and will not work for tropical and west African species or hybrid taxa.

Key to genera previously included under *Asclepias sensu* Brown (1902 & 1908)

1a. Plants with stems decumbent or prostrate along the ground 2

1b. Plants with stems erect 3

2a. Leaves ±ovate, often as wide as broad. Corona-lobes saccate or slipper-shaped, usually longer than tall. Anther-wings without a distinct notch along its length ..... *Pachyacris*[**]

2b. Leaves more or less linear, longer than broad. Corona-lobes turriform, always taller than long. Anther-wings with a distinct notch somewhere along its length ..... *Bruynsia*

3a. Corona-lobes turriform. Anther-wings with a distinct notch somewhere along its length ..... *Bruynsia*

3b. Corona-lobes not turriform. Anther-wings smooth & straight, without a notch ..... 4.

4a. Flowers cream, white, greenish white, pinkish white or yellow in color ..... 5.

4b. Flowers purple, brown, green or a mixture of these, never pure yellow, pure white or with a predominance of these colors ..... 8.

5a. Plants shrubby. Rootstock shallow & fibrous ..... *Gomphocarpus*

5b. Plants herbaceous or subshrub. Rootstock a deep-seated woody or fleshy stem-tuber ..... 6.

[**] Watch out for *Pachyacris macropus* in which the distal portion of the corona is elongated and erect making it appear to be taller than long. To ensure correct identification check to make sure there is no notch in the anther-wing.

6a. Plant herbaceous, usually with only one stem or occasionally with up to 3, but then these never branched. Stems solid. Leaves always linear & never glaucous 7

6b. Plant a subshrub with many stems, or if only one stem then this always branched. Stems hollow. Leaves if linear then not glaucous, if ovate or lanceolate then glaucous ..... *Gomphocarpus*

7a. Plants with yellow flowers. Corona-lobe with a central tongue-like sinus appendage. Rootstock a globose or ovoid stem-tuber ..... *Aspidonepsis*

7b. Plants with cream, white or pink flowers. Corona-lobe without a central sinus appendage. Rootstock a deep-seated woody cylindrical stem-tuber ..... *Paulforstera*

8a. Corona-lobe with a sinus appendage 9

8b. Corona-lobe without a sinus appendage 11

9a. Plants almost shrubby, stems when mature ±800mm or more tall. Corona-lobe sinus appendage horn-shaped. Plants of American origin .... *Asclepias*

9b. Plants herbaceous. Stems if one then erect and 800mm, if more than one stem then only 200mm long and decumbent. Corona-lobe sinus appendage tongue-shaped. Plants of southern African origin 10

10a. Stems usually one (rarely 3 in *A. flava*), erect. Rootstock an ovoid stem-tuber ..... *Aspidonepsis*

10b. Stems usually as many as five or more (seldom one), procumbent. Rootstock a deep-seated cylindrical stem-tuber ..... *Bruynsia*

11a. Corona-lobe sinus filled with basal papillae ..... *Trachycalymma*

11b. Corona-lobe sinus without papillae 12

12a. Flowers large, 20mm to 70mm in diameter. Fruits large, leathery and inflated ..... *Pachycarpus*

12b. Flowers small, 5mm to 15mm in diameter. Fruits long, thin and not inflated 13

13a. Peduncle more than 100mm long, often as much as 140mm 14

13b. Peduncle less than 95mm long 15

14a. Stems thin & wiry from base. Leaves narrowly linear, 0.3 to 5.0mm wide. Flowers yellow. Follicles smooth ..... *Aidomene*

14b. Stems thick at the base. Leaves broadly linear to lanceolate, 5 to 22mm wide. Flowers pink or pinkish green. Follicles rugose to almost echinate ..... *Pachyacris*

15a. Plants with a single, erect stem. Flowers yellow or yellow & brown. Rootstock a globose stem-tuber ..... *Aspidonepsis*

15b. Plants with a number of stems, if one stem then flowers purple, green or purple-green. Rootstock a deep-seated cylindrical or carrot-shaped stem-tuber 16

16a. Leaves broadly rounded to slightly cordate at the base, margins often crispate. Corona arising at 1mm above corolla, subquadrangular with a shallow and narrow central fissure. Fruits with 4 small wings ..... *Sigridia*

16b. Leaves tapering at the base, margins never crispate. Corona arising at the corolla base, slipper-shaped with a large central sinus. Fruits smooth ..... *Aidomene*

GOMPHOCARPUS R. Br, On the Asclepiadeae (a natural order of plants separated from the Apocineae of Jussieu): 37 [1810], preprint of. Mem. Wern. Nat. Hist. Soc. 1: 12—78 [1811]. **Type species:** *G. fruticosus* (L.) Ait. f. [Basionym:. *Asclepias fruticosa* L.] Lectotype designated by Bullock, 1952: 406.

Gomphocarpus E. Mey., section *Eugomphocarpus* Decne., in DC. Prodr. 8: 557 [1844]. **Type species:** *G. fruticosus* (L.) Ait.f. [Basionym:. *Asclepias fruticosa* L.] Selected here.

Description: *Habit*: Usually perennial, occasionally annual or biannual, herb, subshrub, shrub or almost tree-like; with milky latex. *Underground-organ:* Usually fibrous rarely a swollen, deep-seated, woody stem-tuber. *Stems* 1–20, erect, usually much branched near the base or higher up, rarely few branched or solitary, teretee, glabrous to velutinous, 0.5—3.0 m tall, hollow. *Leaves* usually opposite, rarely whorled, spreading to spreading erect, simple, entire, sessile or petiolate; blade usually linear & occasionally slightly falcate, occasionally lanceolate, ovate, 35—150mm long, 1—65mm wide or absent, usually thinly textured, occasionally glaucous or coriaceous, apex acute to obtuse, occasionally apiculate to mucronate, base tappering round, cordate to hastate & occasionally clasping, usually all level of veins prominent, occasionally only midrib prominent, usually glabrous; petioles 0—9mm long. *Inflorescences* umbel-like, rarely clustered, terminal & lateral at the nodes, often numerous on an individual, pendulous, 4—20-flowered; peduncle (3.4-)12.0—45.0mm long; bracts linear to filiform or awn-like, 3—8mm long, 0.7—1.0mm wide, caducous. *Flowers* rotate, cream, white or greeny white, corona sometimes dark brown; pedicel 9—32mm long. *Calyx* 5-merous, lobes ovate to lanceolate, 2.0—11.5mm long, 1.0—2.5mm wide, usually green with tip purple. *Corolla* 5-merous, more or less divided to base, spreading to reflexed; lobes ovate, oblong, to elliptic, 4.5—9.0mm long, 3.0—6.7mm, apex acute, subacute to obtuse, margin slightly revolute & fringed with white hairs. *Staminal-corona* in 1-series, 5-merous, produced from between 0.75—1.7mm above the gynostegial-column base, 5-merous, shorter than to overtopping the style-apex; lobes fused to staminal-curtain below, free above, laterally compressed, saccate, subquadrate to D-shaped in side view, about as tall (7—10mm) as broad (5—10mm), proximal upper ends obtusely rounded, shortly erect or produced into pointed & often reflexed appendages, upper margins curved

downwards or truncated, distal upper end blunt or curved, outer margin (= keel) straight or rounded, side surfaces with basal ridges that act as guide-rails during pollination, sinus a narrow, central channel, rarely with an inner-appendage, white, yellow or dark brown. *Staminal-column*: Anther–appendages suborbicular, obtuse, lanceolate, ovate or elliptic, membranous, white, reflexed onto the style-head or its margin; anther–wings obliquely vertical, smooth, sharply right angled at the base, occasionally quite prominent. *Pollinaria*: Pollinia solitary, pendulous in each anther-sac, obclavate to lacrimiform, often large; translator–arms thin, once bent, attached apically to pollinia; corpusculum ellipsoidal. *Style-apex* truncated & sunk in the middle. *Follicle*: Solitary by abortion, erect, narrowly fusiform, ovoid, ellipsoid, subglobose to globose, sometimes hemispherical or obliquely ovoid, sometimes inflated, 30—125mm long, (6-)20—80mm wide, apex short & pungent, attenuated into a very long beak or rounded, base rounded, rarely tapering, thinly or thickly skinned, smooth or with a sparse to dense covering of echinate bristles ±20mm long or with 6 narrow (entire or toothed) wing-like ridges that may become bristle-like apically, pedicels recurved or straight in fruit. *Seeds*: dorso-ventrally flattened, adaxial surface shallowly convex, abaxial surface shallowly concave, ovate to oblong ovate, 5.5—7.5mm long, 2.2—7.0mm wide, surface verrucose, apex with a coma *Etymology*: From the Latin, *Gompho* (= club), *carpus* (= fruit) in reference to the fruit shape.

Discussion: *Gomphocarpus* can be separated from other genera of the Asclepiadinae by the possession of the following set of correlated characters: Shallow fibrous rootstock, shrubbiness, hollow stems, extra-axillary, laterally produced and pendulous inflorescences, whitish or (in the case of some extra-southern African species) yellowish flowers, saccate corona-lobes, and inflated, echinate follicles. Due to heterobathmy one or two species may show exceptions to some (but not all) of these characters; see discussion under each species. *Gomphocarpus* is a widespread genus occurring naturally from Arabia, through Africa to South Africa. This is a genus of about 18 species with 9 in southern Africa. The genus *Gomphocarpus* can be divided into two subgenera. The type subgenus is the largest and in southern Africa contains eight species. The second subgenus is much smaller with only one southern African member. Some species are used for *muthi* (= indigenous medicines).

Distribution: Old World endemic. Widespread, occurring all over Africa, Mediterranean Europe & islands and Arabia. Introduced weed in the Americas, Asia, Australasia and the Pacific islands.

Key To Subgenera:

1a. Plants glaucous & waxy; leaf bases hastate to cordate & clasping the stems ..... subgenus *Leiocalymma*

1b. Plants not glaucous & waxy; leaf bases not hastate or cordate and not clasping the stem ..... subgenus *Gomphocarpus*

GOMPHOCARPUS** Subgenus **GOMPHOCARPUS.

Description: *Rootstock* fibrous. *Stems* 1–20, erect, usually much branched near the base or higher up, hollow, usually thin (except for *G. cancellatus* which is thick and almost fleshy), glabrous to velutinous, 0.5—3.0 m tall. *Leaves* usually opposite, rarely whorled, sessile to petiolate, spreading to spreading erect; blades linear & occasionally slightly falcate to lanceolate, 35—150mm long, 1—65mm wide or absent, usually thinly textured or occasionally coriaceous, apex acute to obtuse, occasionally apiculate to mucronate, base tapering, round, cordate to hastate, all level of veins prominent or at least midrib prominent; petioles 0—9mm long; bracts linear to filiform or awn-like, 3—8mm long, 0.7—1.0mm wide. *Inflorescences* umbel-like, terminal and lateral & extra-axillary, pendulous; 4—20-flowered; peduncle (3.4-) 12.0—45.0mm long. *Flowers* cream, white or greeny white, corona sometimes dark brown; pedicel 9—32mm long. *Sepals* ovate to lanceolate, 2.0—11.5mm long, 1.0—2.5mm wide. *Corolla* spreading to reflexed; lobes ovate, oblong, to elliptic, 4.5—9.0mm long, 3.0—6.7mm wide, apex acute, subacute to obtuse. *Staminal-corona* produced 0.75—1.7mm above the gynostegial-column base, lobes subquadrate to D-shaped in side view, about as tall (7—10mm) as broad (5—10mm), proximal upper ends obtusely rounded, shortly erect or produced into pointed & often reflexed appendages, upper margins curved or truncated, distal upper end blunt or curved, outer margin (= keel) straight or rounded, sinus rarely with an inner appendage, white, yellow or dark brown. *Staminal-column*: Anther–appendages suborbicular, obtuse lanceolate, ovate or elliptic; anther–wings only sometimes quite prominent. *Follicle*:

narrowly fusiform, ovoid, ellipsoid, subglobose to globose, sometimes hemispherical or obliquely ovoid, sometimes inflated, 30—125mm long, (6-)20—80mm wide, apex short & pungent, attenuated into a very long beak or rounded, base rounded, rarely tapering, thinly or thickly skinned, smooth or with a sparse to dense covering of echinate bristles ±20mm long or with 6 narrow (entire or toothed) wing-like ridges that may become bristle like apically, pedicels recurved or straight in fruit.

Discussion: In southern Africa two species, *G. physocarpus* and *G. fruticosus*, are successful weeds along roads and in disturbed areas. These species (and their hybrids) have now become successful, but undesirable, invasive plants in most warm regions of the world from the West Indies to Hawaii. A third species, *G. cancellatus*, has also become a serious, nuisance weed in parts of Australia (Forster, 1996). The weedy properties of some members of this genus are, amongst other things, possible because they possess a fibrous rootstock rather than a deep-seated fleshy stem-tuber (like most other genera in the Asclepiadinae). Unlike fibrous roots, stem-tubers take many years to establish themselves. *Gomphocarpus* subgenus *Gomphocarpus* shares a fibrous root system with the rheophytic sister genus *Kanahia*. Amongst other adaptations, shallow fibrous roots are a prerequisite for the precarious rheophytic life-style. Recently collected data indicates that *Gomphocarpus* and *Kanahia* probably evolved from a rheophytic, Kanahia-like ancestor (paper in preparation). In fact, one species of *Gomphocarpus*, *G. rivularis*, is a rheophyte with vegetative, inflorescence and fruit structure that is intermediate between *Gomphocarpus* and *Kanahia*. However, the majority of other characters place this species within *Gomphocarpus* rather than *Kanahia* but it does suggest a phylogenetic link between the two genera. Because of their fibrous rootsystem and ability to reach reproductive maturity within a year, members of this genus are capable of surviving as either annuals, biennials or perennials; unlike their geophytic stem-tubered relatives which are long lived but slow to mature. Their generally shrubby habit enables them to produce numerous inflorescences. This floribund nature, combined with an abundance of pollinators (apparently they are primarily meltiophilous) and probably the ability to self-fertilize, ensures good seed set. All these factors combine to make these species the precocious, successful pantropical weeds they have become. *G. physocarpus* has become a popular garden plant in South Africa.

Bullock took a very broad view of species limits within *Gomphocarpus*; one with which these authors do not fully concur. *G. decipiens* and *Asclepias burchellii* (= *G. tomentosus*) were sunk by him under *G. fruticosus*, but there is evidence from both herbarium and field studies that *G. tomentosus* does not intergrade with *G. fruticosus*. For the most part both appear to breed true to their kind even in situations in which hybridization could be expected to occur. Other species found in tropical Africa also sunk by Bullock (e.g. *Asclepias albidus*), also appear to be reproductively and morphologically distinct. Species circumscribed in this paper apply to these taxa as they occur in southern Africa only. Many of the features cited as diagnostic, break down or do not work when applied to these species as they occur further north in Africa.

Key To Species of Subgenus *Gomphocarpus*:

1a. Plants rheophytic, with leaves 3 from a node ..... *G. rivularis*
2b. Plants not rheophytic, with leaves 2 from a node 2

2a. Plants almost leafless, leaves no more than 2mm wide; follicles narrowly fusiform & smooth ..... *G. filiformis*
2b. Plants with conspicuous leaves more than 2mm wide; follicles echinate, sparsely warty, rugose or smooth 3

3a. Plants with younger part conspicuously covered in dense white hairs 4
3b. Plants with younger parts glabrous or only a few hairs 7

4a. Corona-lobes D-shaped in side view, without a reflexed, tooth-like falcate-shaped upper proximal appendages 5
4b. Corona-lobes square in side view, with a reflexed tooth-like falcate-shaped upper proximal appendages 6

5a. Flowers ±10mm in diameter ..... *G. tomentosus*
5b. Flowers ±20mm in diameter ..... *G. otiocephalus*

6a. Corona-lobes with upper margin straight & with reflexed tooth-like falcate-shaped upper proximal appendages ..... *G. fruticosus*

6b. Corona-lobes with upper margin sinuate or wavy & without any proximal appendages ..... *Gomphocarpus sp. nov.*

7a. Follicles smooth & with apical beak ±25mm long ..... *G. rostratus*

7b. Follicles echinate & apical beak no more than 20mm long 8

8a. Leaves coriaceous & oblong-lanceolate to elliptic; follicles leathery ..... *G. cancellatus*

8b. Leaves delicate & ±linear; follicles thinly textured 9

9a. Plants usually with a single stem branched well above ground; follicles globose & unbeaked ..... *G. physocarpus*

9b. Plants many stemmed, branched from ground level; follicles ovoid & with a beak at least 15mm long ..... *G. fruticosus*

1. Gomphocarpus rivularis Schltr., in Bot. Jahrb. 20(5). Beibl 51: 36 [1895]. **Type:** *Schlechter 3789,* South Africa, Mpumalanga province, river near Middleburg, 25.11.1893, 1630m. [Holo. B† Iso. BM, GRA, K fragment, MEL *fide* Forster].

Asclepias rivularis (Schltr.) Schltr., Journ. Bot.: 455 [1896]. **Type:** As above.

Discussion: This species bears some similarity to the genus *Kanahia*, as such it is an interesting and unusual species within the genus *Gomphocarpus*. The possession of hollow stems, fibrous rootstock, interpetiolar and axillary colleters, inflorescence structure (which is not quite umbelliform), and ellipsoid fruits suggest that it may be phylogenetically related to *Kanahia laniflora* (Forssk.) R. Br. Although, the similarites between the two could also be interpreted as parallelisms due to living in the same kind of habitat or even due to some distant hybridization event between the two genera. The overall habit and floral morphology, especially that of the inflorescence and corona-lobe structure place *G. rivularis* well within *Gomphocarpus* rather than *Kanahia*. The fruit of

G. rivularis is interesting because, although usually smooth (a feature of *Kanahia*), it may also sometimes be sparsely echinate (a gomphocarpoid feature). *G. rivularis* can be distinguished from *Kanahia* by its leaves which arise three from a node, smaller flowers, fully pendulous inflorescences and saccate corona-lobes whose upper margin is flush with the style-apex. Its rheophytic habit, deep maroon coloured stems, possession of colleters, leaves in threes from the node, inflorescences compressed but not fully umbelliform and ellipsoid fruits set *G. rivularis* apart from all other *Gomphocarpus* species in South Africa. This species is found at altitudes of between 750 and 1500 meters and flowers around December. Unlike other *Gomphocarpus* species the follicle has a tough leathery pericarp that is either smooth or with a sparse covering of spines, there are colleters at the petiole base and the inflorescences are compressed rather than fully umbelliform (fig. 6).

Distribution: Southern African endemic. South Africa [North West, Mpumalunga, Free State, Eastern Cape and Kwazulu-Natal provinces] and Swaziland (fig. 3).

Conservation status: Low Risk (Least Concern). The fact that South Africa's population will finally outstrip the subcontinents' water resources in about the year 2018, has lead to massive tampering with the countries water supplies. The building of dams, pumping of water from Kwazulu-Natal rivers over the Drakensberg to Gauteng, especially Johannesburg, long periods of *el nino* induced drought lasting several years, and increasing water pollution will all impact on the habitat and well being of this species. Although not endangered now, its long term survival (along with that of many other non-weedy rheophytic and hydrophytic plants) is doubtful.

Representative Specimens: South Africa: North West: *Leendertz 3223*, Potchefstroom [GRA]; *Leendertz 7985*, Potchefstroom [PRE with photos]; *Burtt Davy 2174*, Potchefstroom [NH]; *van Wyk 930*, Potchefstroom [PRE]. Gauteng: *Zeyher 1166*, Magalisberg [SAM]; *Sim 19125*, Springs [PRE]; *Phillips s.n.*, Bronkhorstspruit Drift [J A18]; *de Winter 7696*, Bronkhorstspruit [PRE]; *Balsinhas 3001*, Pretoria [PRE]. Mpumalanga: *Van Wyk, Dahlgren & Kok 5501*, near Middleburg [PRE]; *Dyer 4689*, Piet Retief ditrict [PRE]; *Rademacher 9603*, Carolina [PRE]; *Williams 6824*, Machadodorp [PRE]; *Munro s.n.*, Greylingstad [PRE]; *Kluge 2292*, Nelspruit [PRE]. KwaZulu-Natal: *Bayer 1420*, Ellesmere, Dumisa [NU, PRE]; *Shirley s.n.*, Ixopo district [NU 6791/16];

Rudatis 365, Ifafa, Fairfield [STE]; *Colman 329,* Kokstad [NH]; *Tyson 1688*, Kokstad [SAM]; *Brusse 4283*, Mount Currie district [PRE]. Eastern Cape: *Flanagan 485*, Kabousie river [NH]; *Flanagan 2815*, Komga [SAM]; *Hilliard 1055*, Lusikisiki [NU]; *Barker 3434*, Inverthorn [NBG]; *Baur 487*, Bazeia/Iumancu [SAM]; *Schlechter 6541*, Umzumhlava [BOL, JF, STE]; *Rogers 12801*, Stutterheim [PRE]. **Swaziland:** *Dlamini s.n.*, Mlilwane river, Manzini district [NBG 58405].

2. *Gomphocarpus physocarpus* E. Mey., Comm. Pl. Afr. Austr.: 202 [1838]. **Type:** *Drège s.n.* in *Herb. Benthamianum*, '*Gomphocarpus physocarpus* EM. a', South Africa, Eastern Cape Province, by stream near Glenfilling, alt. 500ft (= 152m) [Lecto. K]. Designated by Goyder 1988 (fig. 3). *Drège s.n.* [Isolecto. BM, K].

Asclepias physocarpa (E. Mey.) Schltr., in Journ. Bot. 34: 453 [1896]. **Type:** As above.

Asclepias fruticosus sensu Mill. Dict. edn. 8, 13, *non* L., in Sp. Pl. 1: 216 [1753].

Gomphocarpus fruticosus sensu Sims, in Bot. Mag. t.1628 *non* (L.) Ait. f. Hort. Kew. ed. 2(2): 80 [1811].

Gomphocarpus frutescens (in error for *fruticosus*) Dietr., Syn. Pl. 2: *pro parte*.

Discussion: The typification of this species has been dealt with by Goyder (1998). If only fruitless portions of this plant are preserved on herbarium specimens, then this species can sometimes be difficult to distinguish from *G. fruticosus*; a fact that has lead to problems with the typification of *G. fruticosus*. In the field or if fruit is present then these two species cannot be confused. *G. physocarpus* produces a single long (± 800mm) stem before producing 3 or more branches well above ground level or near the apex, follicles that are globose in shape and shortly beaked, and differently structured corona-lobe. *G. fruticosus* is, as the name suggests, fruticose or shrubby and tends to branch profusely from the base at ground level, the follicles are ovoid (often slightly falcate) with a long apical beak. In southern Africa, *G. physocarpus* occurs naturally only in the moist band along the southern and eastern coasts, whereas *G. fruticosus* is widespread in the drier interior. Both species will, however, hybridize mostly in those marginal, sympatric areas where humankind has disturbed the landscape. Specimens of *Gomphocarpus fruticosus*

were introduced into the Sydney area as early as about 1792 (*c.f.* specimens collected at about this time in Australia by *Jacob s.n.* & *Burnett s.n.* both housed at Kew), probably brought by ship(s) which docked at South African ports on their way. The time of introduction of *G. physocarpus* is not known, but hybrids between this species and *G. fruticosus* have been recorded in Australia in 1884 (*Stephenson s.n.* at Kew). Such *G. fruticosus* and *G. physocarpus* hybrids seem to have become more common in recent time and Forster (1996) mentions that these hybrid swarms are commonly encountered. Possibly barriers that operate to keep these species separate in Africa do not operate in the same way or to the same extent in Australia? Plants from here and in the adjacent Pacific Islands (including Hawaii) have specimens which combine characters from both, and thus cannot be assigned to either species. With these species having now been isolated in Australia for over 190 years, it is probable that natural selection and the founder effect have already started to change the gene pool of this species on this continent. This may explain why specimens collected here are often not typical of their African counter parts. Hybrid swarms are also encountered in South Africa (personal observations & Brown, 1908) but they are not frequent except in the coastal areas from Uniondale (on the east coast) to Hopefield (on the west coast). Some specimens collected are almost midway between *G. physocarpus* and *G. fruticosus* var *fruticosus* in morphology, especially noticeable in the corona-lobes and follicle (*Rogers 15456, Viviers 312, Basson s.n., Jordaan s.n., Rudatis 63*). Others are a combination of characters. *Smart PAR15458* has the habit of *G. physocarpus* and the flowers of *G. fruticosus*, while *Burgers 2960* has the habit and flower of *G. physocarpus* and fruit more like *G. fruitcosus*. Some are clearly *G. phyosocarpus* but with a few, mainly floral, characteristics that are *G. fruticosus* (*Thompson 540, Bohnen 4154, STE 14891*). A smaller number are clearly *G. fruticosus* but with a few floral features that are *G. physocarpus* (*Bachman 1128*) (fig. 4). Hybrid swarms have also been recorded in tropical Africa (Bullock, 1952).

Further north in Africa, *G. phyoscarpus* appears to grade into *Gomphocarpus semilunatus* A. Rich. and it can be difficult to distinguish them sometimes. However, *G. semilunatus* seems to prefer growing in swampy grassland areas, unlike *G. physocarpus* and certainly unlike *G. fruticosus* which occurs in drier situations; being common along road verges. *G. semilunatus* typically has a shorter, more incised corona-lobe than *G.*

phyoscarpus, although this character tends to break down in Zambian specimens. In east Africa *G. phyoscarpus* tends to be a shorter, more stiffly branched plant than *G. semilunatus*. Interestingly, a few specimens of *G. physocarpus* or *G. semilunatus* collected further north in Africa sometimes have 3, or in the case of *G. semilunatus* even 4, leaves to a node as in *G. rivularis*. In fact, in several tropical African collections of *G. physocarpus* and *G. semilunatus* the leaves are not always strictly opposite. Specimens of *G. physocarpus* in southern Africa, however, always have strictly opposite leaves which are 2 from a node (fig. 1).

The Zulu names for this species are *uSingalwesaluazi* or *Qomantanetu*, the Venda name is *Mutshule*, while English common names include Fairy Appels, Bishop's Balls and Balloon Cotton-bush. *G. physocarpus* occurs in the coastal areas of the continent. Plants may be found growing in grasslands, dunes, coastal sandflats, open grassland, forest margins, or more commonly, in disturbed areas along roadsides or in fallow farmlands. They are some of the first plants to appear in dune forest areas that have been stripped mined (Camp in Weisser, 1987) for titanium. They can be found occuring at altitudes ranging from 30 to 700 meters, rarely up to as much as 900 meters and flower between September and May. This species is reported to be poisonous, with as little as 300gm causing fever, weak respiration and eventually death (Watt & Breyer-Brandwyk, 1962). The stems are a source of fibre and at the turn of the century the silky coma on the seeds was used to stuff pillows and cushions (Wood 1902). It is also used widely as a medicine, especially in Africa. The Zulu take powdered leaves as a snuff for headaches (Hutchins, 1996). A few animal-plant interaction studies (both herbvory and pollination) have also been carried out on this species (Bullock, 1963a & Forster, 1994). Apparently, plants are visited by numerous insects including Diptera and Hymenoptera, but of these only the common bee and Cetoniid beetles are pollinators (Bullock, 1963a). In KwaZulu-Natal, the senior author has noted an abundance of large wasps visiting flowers in the early morning; this fits with the results given for the genus *Gomphocarpus* given by Ollerton & Liede (1997). *G. physocarpus* has become naturalized in Australia (Forster, 1996), this is discussed in more detail under *G. fruticosus*. Illustrations can be found in Wood 1902, Malaise 1985, Haselwood & Motter 1991 and Forster 1996. The illustration in Hermann 1698 is extremely inaccurate.

Distribution: African endemic found along the eastern and southern margin of the continent from Kenya and Rawanda to South Africa. In southern Africa it is found in South Africa [Western Cape, Eastern Cape, Kwazulu-Natal, Mpumalanga, North West & Northern provinces] and Swaziland (fig. 3). It is an introduced weed in Nigeria, West Cameroon, Cape Verde Islands, Mauritius, India, Sri Lanka, Hong Kong, Australia, Norfolk Islands, West Indies and possibly elsewhere.

Conservation Status: Ubiquitous indigenous weed of no conservation concern. Also widely cultivated.

Representative Specimens: South Africa: Northern: *Hemm 357*, Tshamanyatsha [J]; *Hemm 1079*, Luphephe Dam [J]; *Bos 1358*, Hangliphos reserve, near Louis Trichardt [STE]; *Obermeyer 1218*, Zoutpansberg [PRE]; *Jacobsen 1197*, Ohrigstad Nature Reserve [PRE] North West: *Lanham 4*, Rustenburg [PRE]. Mpumalanga: *Rushworth 27*, Chester farm, near Pilgrims Rest [NU]; *Rogers 25100*, Sabie [J]; *Stalmans 770*, Lekgalameetse Nature Reserve [PRE]; *Onderstall 999*, Nelspruit [PRE]; *Jacobsen 5406*, White River district [PRE]; *van der Schÿff 5892*, Mariepskop [PRE]; *Holt 164*, Barberton [PRE]. KwaZulu-Natal: *Baijnath 195*, Merebank [NU, PRE, UDW*]; *Nicholas 606*, Pietermaritzburg [NU]; *Nicholas 672*, eastern shores of Lake St. Lucia [CPF, NH]; *Nicholas 978 with G. Nicholas*, Near Park Rynie [NU]; *Nicholas 997*, near Port Shepstone [K, NH]; *Nicholas 1256*, Western Shores, St. Lucia [CPF]; *Nicholas 2785 with DC Nicholas,* Between Harding & Padock [UDW]; *Nicholas 2713 with Baijnath*, Durban [UDW]; *Nicholas 2713 with Powel*, Near Itala [UDW]; *Venter 3911*, Nkandla [BLFU, PRE]; *van Wyk 7018*, Ngome Staatsbos [PRE]; *Thekala 3*, Westville [UDW]; *Taylor 5269*, Rooi Vaal [NBG]; *Ward 5*, Isipingo [UDW]; *MacDevette 1157*, Mosi State Forest [CPF]; *Ward 5641*, Majozini [UDW]; *Goodman 346*, Mkuzi [Mkuzi**]; *Thode 6362*, Pietermaritzburg [JF, STE]; *Johnson 48*, Hluhluwe Game Reserve [NBG]; *Schlechter 2805*, near Isipingo [J]; *Ward 330*, Isipingo [NU, UDW]; *Galpin 11958*, Richmond [PRE]; *McKen 511*, near Durban [TCD]; *Sikhakhane 76*, KwaMbonambi [PRE]; *Wells*

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* The Ward Herbarium of the Botany Department, University of Durban~Westville has not yet been allocated an acronym. As a result, we have choosen to represent this herbarium using the abbreviation UDW

** The Natal Parks Board herbarium at Mkhuzi Game Reserve has not yet been allocated an acronym. As a result, we have choosen to represent this herbarium with the acronym Mkhuzi.

1170, Nagk dam [PRE]. Eastern Cape: *Nicholas 2798 with DC Nicholas*, Between Fort Beaufort & Seymour [UDW]; *Nicholas 2829 with DC. Nicholas*, Between Kei Mouth & Komgha [UDW]; *MacOwan 200*, Cunnes Kloof near Grahamstown [GRA, NH, PRE, TCD]; *Duckworth 201*, Cwencwe, Amatola Forest [NH]; *Jacot-Guillarmod 10079*, Bloukrans valley [GRA, PRE]. *Giffen 1078*, Hogsback [UFH]; *Moss 15048*, Hogsback [J]; *Glass 275*, Grahamstown [SAM]; *Tyson 2016*, Clydesdale [BOL, JF, SAM, STE]; *Bayliss 3130*, Hamburg [NBG]; *Krupko s.n.*, Port St. Johns [J 27274]; *Wood 121*, Oakazana [NU]; *Zeyher 524*, Zwartkop River, Uitehage district [BOL, JF, STE]; *Jacot Guillarmod 9469*, Junction of Kap & Great Fish Rivers [PRE]; *Gibbs Russell 3143*, Hogsback [UFH]; *Acocks 9758*, Pefferkop [PRE]; *Bayliss 1083*, Cape St. Francis [PRE]; *Burrows 3167*, Boknes Strand [GRA]; *Jarman 7*, Alexandria district [GRA]; *Brink 479*, near Grahamstown [PRE]. Western Cape: *van Niekerk 441*, Noord Hoek [NBG]; *Marsh 1181*, near Stillbaai [STE]; *Parker 3762*, Somerset West [NBG]; *Compton 23116*, Ottaquas Kloof [NBG]; *Marsh 1181*, Riversdale district [STE]; *Bohnen 4154*, Stillbaai hill [STE]; *Thompson 540*, Kompanjies near Swellendam [STE]; *Visser 7*, Stellenbosch [PRE]. **Swaziland:** *Compton 29261*, Isateki Beacon [NBG, NH]; *Karsten s.n.*, Mpisi [NBG 68827]; *Stewart 85*, Hlatikulu [SAM]; *Miller 7254*, Piggs Peak [PRE]; *Rodin 4206*, Gollel [PRE]; *Barrett 54*, Tshaneni [PRE].

Elsewhere: Mozambique: *Hornby 2582*, Maputo [PRE]; *Mogg 27225*, Inhaca [J]; *Macedo & Macuácua 1115*, Sul-do-save, Chibuto, Baixo Changana [PRE]. Mauritus: *Cronk, Parnell & Wyse Jackson 417*, Magenta Park [TCD]. Australia: *Forster 6257*, Queensland [K]; *Smith 3006*, Queensland [K]; *White 10350*, Queensland [K].

Hybrids with *G. fruticosus*: South Africa: Easter Cape: *Rudatis 63*, Umgaye (Alexandria City) [JF, STE]; *Basson s.n.*, Uniondale [STE 11550]; *Thode A961*, Clarkson [PRE]; *Britten 5942*, Kowie beach [PRE]; *Arnold 475*, Bosberg, Somerset East district [PRE]. Western Cape: *Ecklon & Zeyher 524*, Zwartkop River [SAM]; *Purcell s.n.*, Bergvliet Farm, Constantia [SAM 90755]; *Burger 2960*, De Hoop-Potberg Nature Reserve [STE]; *Smart PAR15458*, Plettenberg Bay [J]; *Jordaan s.n.*, Stilbaai near Riversdale [STE 18384]; *Viviers 312*, Stormsvlei, Bromberg [STE]; *Rogers 15456*, Knysna [J]; *Cooper 1622*, Worcester district [TCD]; *Verreuix Fivrier s.n.*, Cape [TCD]; *Muir 572*, Conente river [PRE]; *Parker 3762*, Somerset West [PRE]; *Smart 22805*,

Plettenberg Bay [PRE]; *Marsh 1181*, Stillbaai turn off on National road, Riversdale district [PRE]; *Scharf 1706*, Groendal Wilderness Reserve [PRE]. Without Precise Locality: *Marloth s.n.* [PRE].

Hybrids with *G. fruticosus* Australia: *Lowne 50*, New South Wales [K]; *Byrnes 3917*, Queensland [K]; *McCornish 58/A*, Norfolk Island [K], *Robert Brown* 2868 [BM].

3. *Gomphocarpus fruticosus* (L.) Ait. f. Hort. Kew. ed. 2(2): 80 [1811]. **Type**: To be epitypified.

Asclepias fruticosa L., Sp. Pl. 1: 216 [1753]. **Type:** As above.

Asclepias glabra Miller, Gard. Dict. edn. 8. no. 12 [1768]. **Type:** '*Asclepias glabra* Mill. Dict. no. 12' [Holo. BM].

A. salicifolia Salisb., Prodr.:150 [1796]. **Type:** As for *Asclepias fruticosa* L.

Gomphocarpus cornutus Decne., in Ann. Sc. Nat. sér. 2(9): 324 [1838]. **Type:** *Bojer s.n.*, Madagascar [Holo. P].

Gomphocarpus frutescens E. Mey., Comm. Pl. Afr. Austr.: 202 [1838]. In error for *fruticosus*.

Gomphocarpus crinitus G. Bertol., Mem. Acad. Sc. Bolog. 3: 253 & t.20, fig. 1 [1851]. **Type:** *Fornasini s.n.*, Mozambique, Inhambane, Dec. 1843 [Holo. BOLO].

Asclepias crinita (G. Bertol.) N.E. Br., in Fl. Trop. Afr. 4(1): 352 [1902]. **Type:** As for *Gomphocarpus crinitus*.

Gomphocarpus brasiliensis Fourn., in Martius, Fl. Brasil. 6(4): 203, t. 53 [1885]. **Type:** *Glaziou 6706*, Brazil, towards Petropoli [Lecto. P. Isolecto. K]. Designated here. *Peckolt 366*, Brazil, near Canta Gallo [Syn. *n.v.*]. Not traced.

Discussion: For this taxon in southern Africa we have taken a slightly narrower concept than did Bullock (1952). *Gomphocarpus tomentosus*, which was sunk by him under *G. fruticosus*, we have kept as distinct and discuss our reasons for this under that species. *G. decipiens* has been reduced to the rank of variety. Wijnands (1983) chose a specimen in the Linnaean herbarium (310.33) as the lectotype, unfortunately, because there is no data on its gross habit or fruit, it is impossible to assign this specimens (or LINN. 310.32 & 310.34) to either *G. fruticosus* or *G. physocarpus*. To establish future nomenclatural stability this name will be epitypified at a later date.

Figure 1. *Gomphocarpus physocarpus*: a. Habit (2 meters tall);b. Lectotype (Drege *s.n.*) housed at Kew; c. Branch with flowers & fruit; d. Inflorescence; e. Flowers with pollinating wasp; f. Close up of flowers. Photographs: a & c to f by A. Nicholas; b by Kew photographer.

Distribution: Old World endemic. Occurring in Arabia, around the Mediterranean, Madagascar and Africa. Southern Africa in Lesotho, South Africa [in all provinces] & Swaziland. Introduced into Azores, India, Australia and Mauritius.

Key to Varieties

1a. Young stems, peduncles & pedicels more or less glabrous; follicles echinate, glabrous & without dark longitudinal stripes ..... var. *fruticosus*

1b. Young stems, peduncles & pedicels usually with a dense covering of white hairs; follicles echinate & with white hairs & dark longitudinal stripes ..... var. *decipiens*

3a. *Gomphocarpus fruticosus* (L.) Ait. f. variety ***fruticosus***

Discussion: This is a very commonly encountered taxon and may be found growing along road sides all over the southern African interior and in fallow farmland, however, it is not confined to these situations and may also be found in short grasslands or sparse scrubveld. It can, apparently, also become a rheophyte (van Steenis, 1981), and in semidesert areas of Namibia it is often found in dry river beds that are usually subjected to seasonal flooding. Plants flower from October to April and occur at altitudes of between 900 to 1500 meters, rarely as low as 45 meters. Under ideal conditions it may form large compact monospecific stands. *G. physocarpus* also does this but in this species the stands consist of more widely spaced individuals. Although *G. fruticosus* var *fruitcosus* species does not usually grow taller than between 0.8 to 1.5 meters, if protected, it can become tree-like and reach almost four meters (fig. 2). The only other genus to do this is *Calotropis*. With *G. physocarpus* this species forms one of the main foods for the African Monarch butterfly which accumulates the poisons it contains to use in its own defence. Difficulty in distinguishing *G. fruticosus* from *G. physocarpus* on herbarium specimens without fruit has been a perennial problem, however, in the field the two species (providing they have not hybridized) cannot be confused. Hybridization between this taxon and *G. physocarpus* are discussed under the latter species. The differences between the two species are tabled below:

Table 1. List of differences between *G. fruticosus* var. *fruticosus* and *G. physocarpus* in southern Africa

Character	***G. fruticosus* var *fruticosus***	***G. physocarpus***
Distribution	Subcontinent interior	Coastal areas
Altitude	(45-)900—1500 meters	30—700(-900) meters
Habit	Stems much branched from ground level	Stem solitary at base few branched high above ground
Leaf venation	Secondary veins not prominent below	Secondary veins prominent below
Flower color	Creamy yellow	White tinted purple
Follicle shape	Fusiform	Globose
Follicle width	25—30mm	38—70mm
Follicle apex	Attenuately beaked	Obtuse & mucronate

Despite its potential nuisance value it is frequently cultivated (van Steenis, 1981), but suffers from carnation vein mottle potyvirus (http://biology). Zulu names for this plant include *inshinga*, *ulusinga Iwesalukazi* and *umsingalwesalukazi*. The Afrikaans name is *blaasoppoes*, while English common names include, amongst others, milkbush, wild cotton, gansies and firesticks. The plant is widely used by all South Africans as a phytomedicine (Hutchings, 1996). The Zulu use leaf infusions to treat diarrhoea and stomach pain in children and as one of the ingredients of *inembe*, an infusion used to ease child birth. An infusion of the plant, used in combination with other unspecified plants, is given as an enema to ease back pain (M.T. Mhlongo personal communication). Early European settlers apparently also used the powdered leaves as a snuff to treat pulmonary tuberculosis (Watt & Breyer-Brandwijk, 1962). The Sotho use the plant as a cure for head colds (Phillips, 1917). According to Dold 1835 with Cocks [GRA] the Xhosa call this plant *Igwada* who dried and powdered the leaves which are then used as snuff to relieve headaches. However, the plants are also known to be poisnous and are suspected of causing human deaths through improper administration. Symptoms of poisoning are mainly respiratory. A number of different cardenolide glycosides, including *gofruside* and *uzarigenin* have been extracted and identified (Fumiko *et al.*, 1994 and Warashina & Noro, 1994). Despite this the rootstock is apparently eaten by people (Guillarmod, 1971), but we suspect this only happens during times of drought and famine. Plants are also

sometimes browsed by goats and cattle. The coma from the seeds are used to stuff pillows and because of their high fibre content the stems have been considered as a possible source of explosive (Watt & Breyer-Brandwijk, 1962). In Arabia the latex is used to remove hair from hides (Miller *et al.*, 1988). *G. fruticosus* var. *fruticosus* is a major source of food for the African Monarch and other butterflies (personal observation and Oyeyele & Zalucki, 1990). Illustrated in Hermann (1698), Watt & Breyer-Brandwijk (1962), Miller *et al.*, (1988), Cribb & Leedal (1982) and Hulton *et al.*, (1991). The plant illustrated in Malaise (1985) is probably of *Asclepias phillipsae* which has at times being considered a synonym of *G. fruticosus*. (fig. 2).

Distribution: As for the species (fig. 5).

Conservation Status: Ubiquitous indigenous weed of no conservation concern.

Representative Specimens: Botswana: *Miller B/377*, Gaberones Forest Plantation [PRE]; *Smith 2601*, Northern district [PRE]; *Mogg 8120*, without precise locality [PRE]. **Lesotho:** *Dieterlen 84*, Leribe [PRE, SAM]; *Watt & Brandwijk 1702*, Morija [PRE]; *Ruch 1547*, Roma [PRE]; *Staples 92*, Maluti Mountains [PRE]; *Chadwick 127*, Khamane [PRE]. **Namibia:** *de Winter 2411*, Farm Otikundua near Steinhausen [NBG]; *Gillman 79*, Windhoek [SAM]; *Dinter 431*, Warmbaths [SAM]; *Moss 17889*, Nabamis near Windhoek [J]; *Tölken & Hardy 609*, between Ariamsvlei to Karasburg [PRE]; *Evrard 9203*, Witpütz-Coogeb [PRE]; *van Wyk 9056*, Lower Orange River valley [PRE]; *Germishuizen 7399*, Gaub farm, near Kombat [PRE]; *Bradfield 104*, Waterberg [PRE]. **South Africa:** Northern: *Obermeyer s.n.*, Chuniespoort, Pietersburg [NH]; *Bredenkamp & van Vuuren 224*, Pietersburg [PRE]; *Westfall 711*, Thabazimbi [PRE]; *Jones 34*, Lapalala Wilderness, Waterberg [PRE]. North West: *Mogg 8120*, Arnoldsvlakte, Vryburg [STE]; *Morris & Engelbrecht 1126*, Lichtenburg [PRE]; *Coetzee 228*, Rustenburg [PRE]; *Theron 1133*, Potchefstroom [PRE]; *van Vuuren 276*, Brits [PRE]; *Leendertz 11402*, Zeerust [PRE]; *Retief 1852*, near Delareyville [PRE]. Gauteng: *Smith 1643*, Pretoria [NH, PRE]; *Nicholas 2705*, Pretoria [PRE]; *Poynton s.n.*, Pretoria [NU]; *Fairall 227*, Waterkloof [NBG]; *HBG (= Gilliland) s.n.*, Limbo Park [J24625 - with photograph]; *Mogg 33083*, Isaac Stegmann Nature Reserve, Portion of Farm Zwartkrans [J]; *Booysen 9*, Suikerbosrand Nature Reserve [PRE]; *Meyer 181*, Dam between Pretoria & Delmas

Figure 2. *Gomphocarpus fruticosus*. a. Small subshrub (0.8 meters tall); b. Small tree (3 meters tall); c. Monospecific stand; d. Flowers & fruit; e. Close up of flowers. Photographs by A. Nicholas.

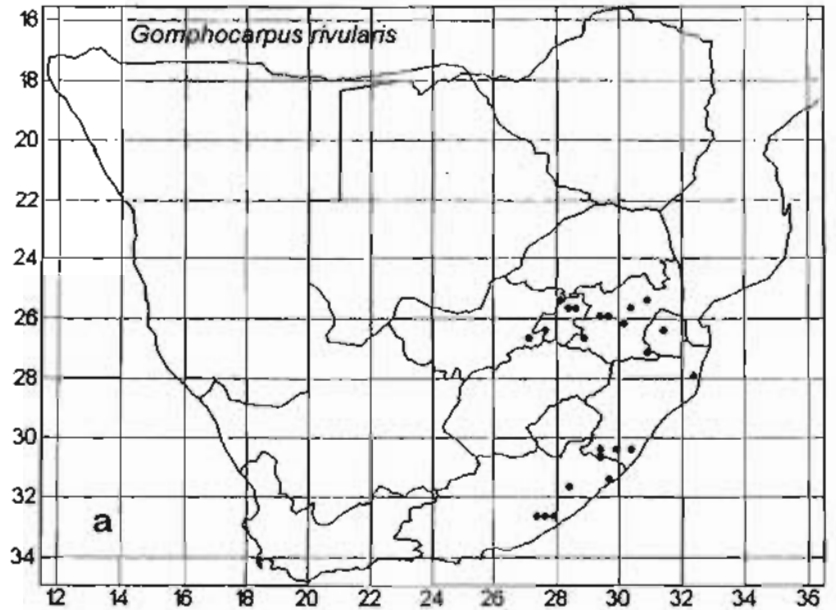
[PRE]; *van Wyk 137*, Carleton [PRE]; *Leendertz 8001*, Heidelberg [PRE]; *Bryant B12*, Johannesburg [GRA]; *Phillips 3015*, Wonderboom [GRA]; *van Wyk 1506*, Dassiesrand [BLFU]. Mpumalanga: *Wilms 950*, near Lydenburg [NU]; *Flanagan 1463*, Vaal River near Hebron [SAM]; *Rudatis 203*, Buffelsvlei [STE]; *Codd & de Winter 5082*, Nelspruit [PRE]; *Leendertz 1116*, Standerton [PRE]; *Rogers 12962*, Komatipoort [PRE]; *Glen 1352*, Barberton [PRE]; *Jenkins 11038*, Volksrust [PRE]. Free State: *Nicholas 1062 with G. Nicholas*, Near Harrismith [CPF, K, NH, NU, PRE]; *Nicholas 2775 with DC Nicholas*, Near Bloemfontein [UDW]; *Nicholas 2779 with DC. Nicholas*, Near Zastron [UDW]; *Nicholas 2781 with DC Nicholas*, Between Zastron & Sterkspruit [UDW]; *Nicholas 2716 with Powell*, Near Aliwal North [PRE]; *Nicholas 602*, Between Bethlehem & Bloemfontein [NU, PRE]; *Pont 22/3*, Kroonstad dist., near Vaal River [BLFU]; *Thode 2585*, Aberfeldy [JF, STE]; *Rycroft 2998*, Kings Hill near Harrismith [NBG, STE]; *Jacobsz 2104*, Drakensberg Botanic Gardens (growing wild) [NBG, PRE]; *van der Zeyde s.n.*, Farm Badenkop, Harrismith [STE 31696]; *Theron 690*, Sasolburg [PRE]; *Retief 1011*, Susannaskop [PRE]; *Roberts 2902*, Thaba 'Nchu [PRE]; *Potts 2588*, Grant's Hill [BLFU]; *Potts 3830*, Kromellenboog spruit, Trompsburg [BLFU]; *Liebenberg 6842*, Golden gate National Park [BLFU]. KwaZulu-Natal: *Williams 117*, Itala Nature Reserve [NH]; *Nicholas 2768 with Poorun & Govender*, Between Loteni & Nottingham Road [UDW]. *Nicholas 2736*, Sunset Farm [UDW]; *Venter 2653*, Umhlatuzi River area [PRE]; *McDonald 129*, Itala Nature Reserve [NU]; *Compton 19742*, Pongola [NBG]; *Rennie 1063*, Mawaqa [NU]; *MacDevette 2027*, Cobham State Forest [PRE]; *Kotze 48*, Eshowe [PRE]; *Vahrmeÿer & Tölken 879*, Ubombo [PRE]. Eastern Cape: *Nicholas 2831 with DC. Nicholas*, near Queenstown [UDW]; *Nicholas 2782 with DC. Nicholas*, Near MacLear [UDW]. *Nicholas 2796 with DC Nicholas*, Hogsback [UDW]; *Nicholas 605*, Between Queenstown & Engobo [CPF, NU, PRE]; *Dold 1835 with Cocks*, Near Pirie trout hatchery [GRA]; *Phillipson 958*, Amatole mountains near Hogsback [UFH]; *Bourquin 13*, Muenyan Mission [NU]; *Bayliss 3424*, Bedford [NBG]; *James 32*, Braemar [NU]; *Wood 5508*, near Ladysmith [SAM]; *Britten 2271*, Southwell [PRE]; Pocock 12346, Burgersdorp [PRE]; *Brink 267*, near Queenstown on Jamestown road [PRE]; *Giffen 1038*, Hogsback [GRA, UFH]; *Bayliss 7848*, near Maclear [GRA]. Northern Cape: *Ferrar 5707*, Kimberley [NH]; *Nicholas 2516*, Hellskloof [PRE]; *Ward 12436*, Orange River

estuary, Oranjemund [NU, PRE, UDW]; *Orpen 87*, St. Clair near Douglas [NBG]; *Moffett & Steensma 4023*, 60kms south of Fraserburg [STE]; *Perry & Snijman 2466*, Nieuwoudtville Reserve [PRE]; *Silk 93*, Bartharus, Kuruman [PRE]; *Leistner 3538*, Kalahari Gemsbok National Park [PRE]; *Retief & Germishuizen 127*, Britstown [PRE]; *Shearing 1133*, Layton [PRE]. Western Cape: *Compton 8504*, Whitehill near Laingsburg [NBG]; *Davidson 51*, Hex River Valley [SAM]; *Boucher 5112*, near Voëlvleidam [STE]; *Moss 5586*, Montague Baths [J]; *Fellingham 457*, Barrydale Junction [STE]; *Humbert 9748*, White hall, Matjiesfontein district [PRE]; *Shearing 453*, Beaufort West district [PRE]; *Breitenbach 32*, Kleinplaat, George [PRE]; *Boucher 5112*, near Voëlvleidam [PRE]; *Palmer 582*, Karoo Nature Reserve [GRA]. **Swaziland:** *Compton 27753*, Malkens [NH]; *Hobson 2151*, near Nyokane below Enkaba trig. beacon [PRE]; *Germishuizen 5941*, Piggs Peak district [PRE]; *Braun 1173*, Hhohho district [PRE]; *Culverwell 666*, Mlawula farm [PRE].

Elsewhere: Zimbabwe: *Collins 111*, Imboga farm, Marandellas [NU]; *Eyles 704*, Harare [SAM]. **France:** *Horwood 35,* Corsica, near Calvi [TCD]. **Spain:** *Bouigeaus 242,* Canary Islands [TCD]. **Australia:** *Coveny 11407*, New South Wales [K]; *Backhouse 376*, NSW, Sydney [BM].

3b. Gomphocarpus fruticosus (L.) Ait.f. ***decipens*** (N.E. Br.) Nicholas & Goyder. *Comb. et stat. nov.* **Type:** *Leendertz 607,* South Africa, Gauteng Province, Wonderboom Poort [Lecto. K. Isolecto. BOL, GRA, PRE]. Designated here (fig. 8). *Schlechter 3589*, South Africa, Gauteng province, Pretoria [Isosyn. BM, BOL, K] (fig. 8); *Conrath 997*, South Africa, Gauteng province, Hennops Valley, near Irene [Isosyn. K]; *Gilfillan ex Galpin 6045*, South Africa, Gauteng province, Johannesburg [K]; *Rand 858*, South Africa, Gauteng province, near Johannesburg [Isosyn. BM]; *Rand 1128*, South Africa, Gauteng province, near Johannesburg [Isosyn. BM]; *Gerrad & McKen 1290*, South Africa, KwaZulu-Natal, Mooi river [Isosyn. BM, K, TCD].

Asclepias decipiens N.E. Br., in Flora Capensis 4(1): 689 [1908]. **Types:** As above.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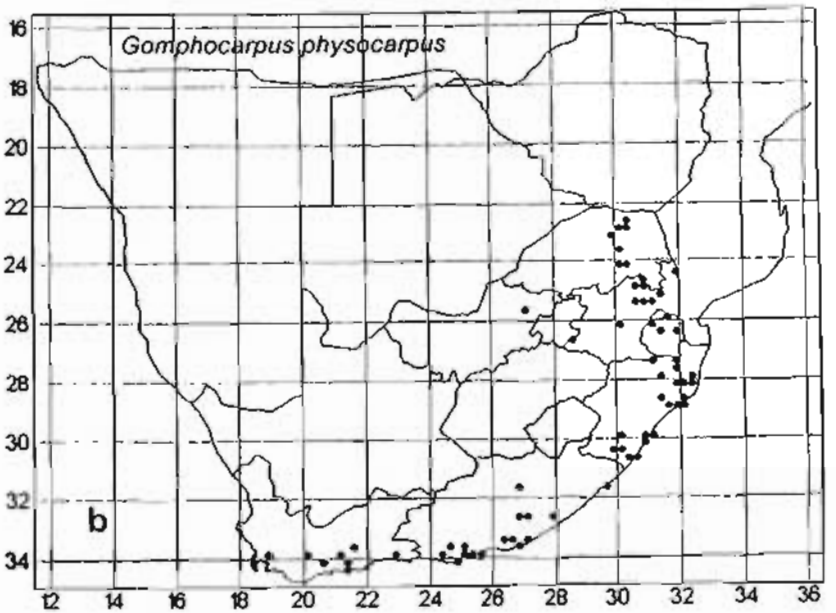
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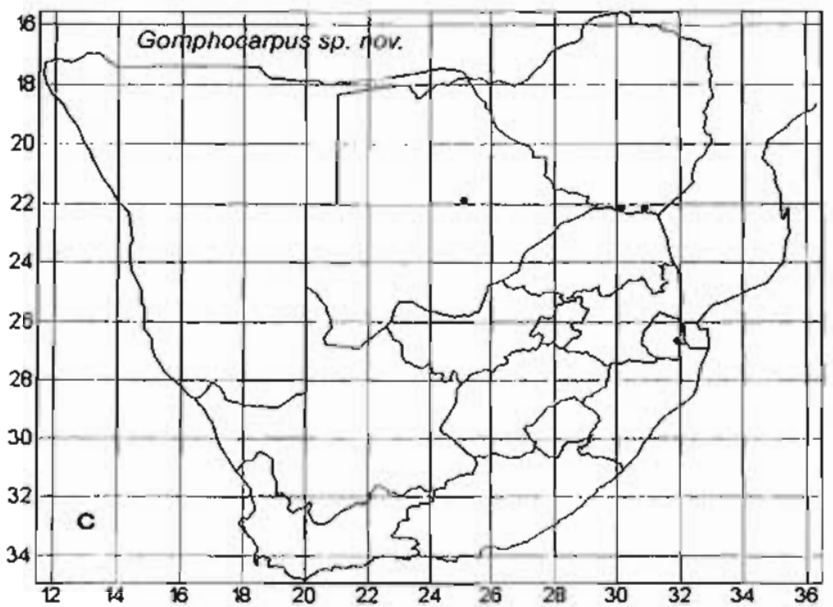
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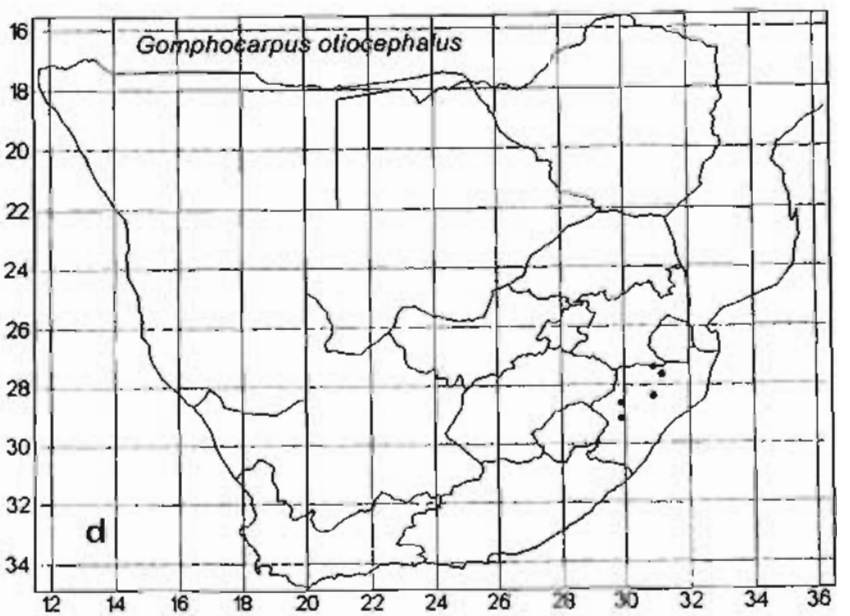
c


Gomphocarpus oliocephalus
d

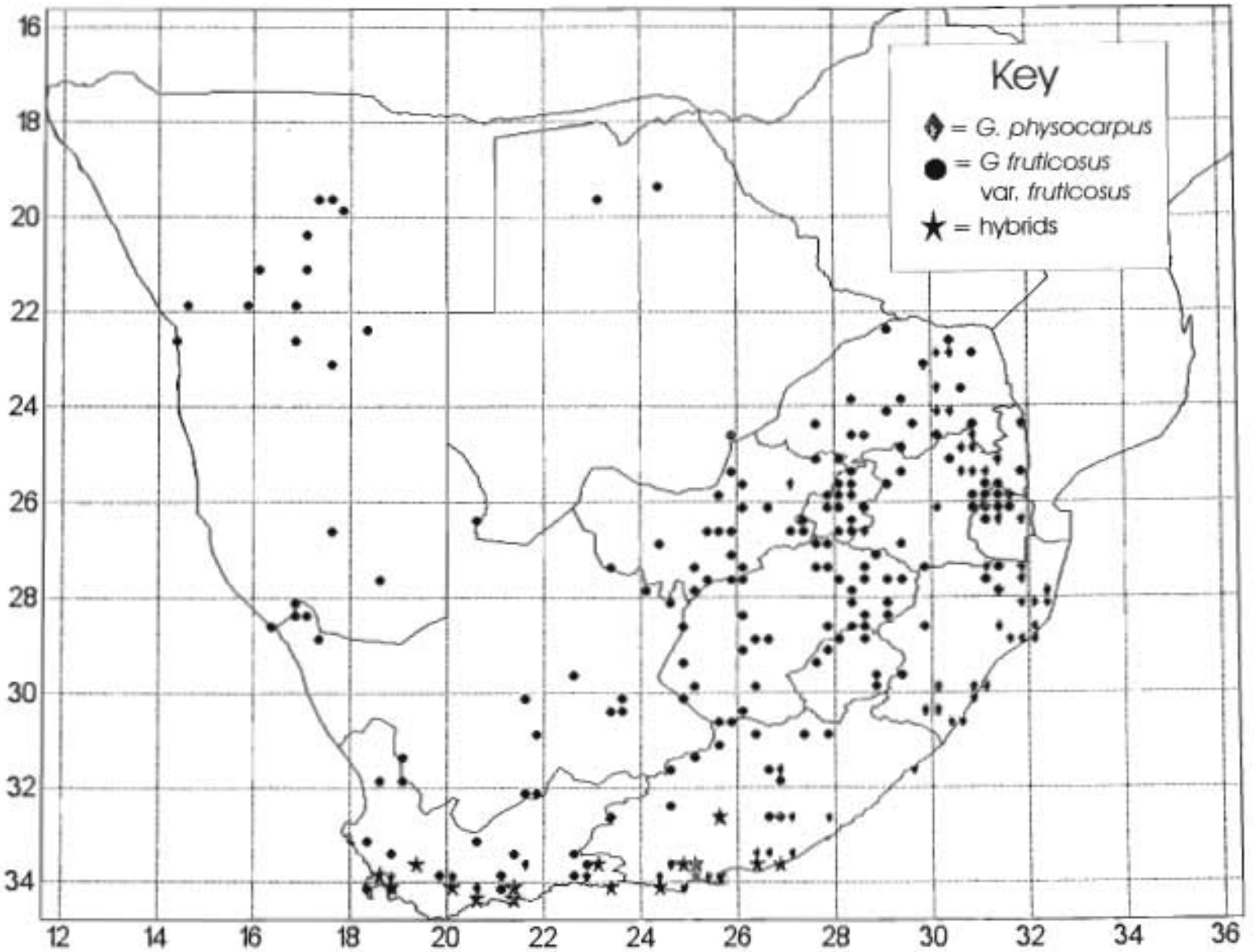


Figure 4. Distribution of *Gomphocarpus physocarpus*, *G. fruticosus* var. *fruticosus* and hybrids between these two taxa.

Discussion: This species was sunk under *G. fruticosus* by Bullock (1952). However, it differs from the type variety in being extremely hairy (white tomentose on the younger parts), less widespread, non-weedy and of slightly different habit (less fruticose with older stems reddish tinted and more woody) and fruit slightly obliquely ovoid, more attenuate at the apex, tomentose and with dark mauve coloured patterning. In all other respects it is exactly like variety *fruticosus*, especially in flower structure and color, and in corona-lobe shape and size. In fact, it is diffcult at times to distinguish the two taxa in herbarium samples. In order to show this taxons relationship to *fruticosus* but still indicate its minor but interesting differences we have decided to allocate it varietal rank under *fruticosus* with which it is conspecific. In its vegetative facies variety *decipiens* is similar to *G. tomentosus*, but this species can be distinguished by its D-shaped corona-lobes and much more velutinously haired young stems, peduncles, pedicels, inflorescence bracts and sepals. Many of the characters of var. *decipiens* are intermediate between *G. fruticosus* var. *fruticosus* and *G. tomentosus* and it may very well be of hybrid origin between the two. Specimens most typical of var. *decipiens* occur at almost all points where *G. tomentosus* meets var. *fruticosus* (fig. 5). Although most common in a locus around Gauteng, var. *decipiens* occurs less frequently elsewhere in adjacent provinces. However, some populations begin to resemble var. *fruticosus*. This intergradation may be due to hybridization between the two varieties; both of which are quite common even in the heavily degraded Gauteng. These hybrid specimens are very problematic and may not run down in the key provided here.

The Sotho use the names *moethimõlo oa thaba* (= he of the mountain who causes sneezing), *molimõlo oa thaba* (= he of the mountain who reveals) and *lebeyana la thaba* (= the small cream of the mountain). The southern Sotho use a snuff made from this species to treat sore breasts (Phillips, 1917) while the Tswana make an ointment which is used for cramp. Plants are found growing in grassy areas, especially rock strewn hillsides. Said to be occasional (fig. 8).

Distribution: South African endemic. South Africa [North West, Gauteng, Mpumalanga, & Free State provinces]. (fig. 5).

Conservation Status: Occuring primarily in Gauteng province there is probably some cause for concern in the long term.

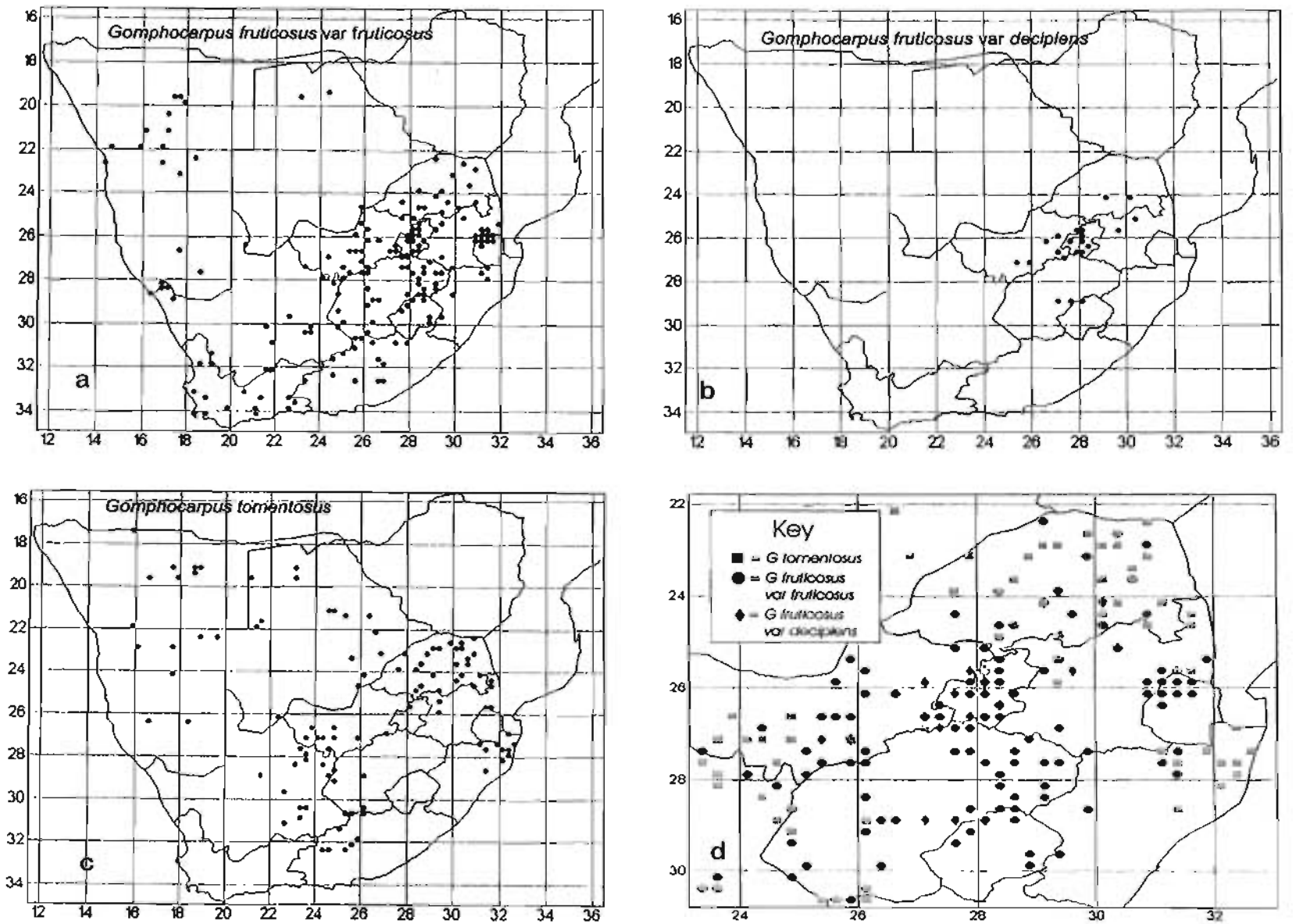


Figure 5. Distribution of: a. *Gomphocarpus fruticosus* var. *fruticosus*; b. *G. fruticosus* var. *decipiens*; c. *G. tomentosus* and; d. Enlarged map of sympatric distribution of all these taxa.

Representative Specimens: Lesotho: *Dieterlen 631*, Leribe [NH, PRE, SAM]; *Dieterlen 583*, Leribe [NBG, PRE]; *Phillips 812*, Leribe [SAM]. **South Africa:** Northern: *Venter 11237*, Klipdraai farm, Wolkberg Wilderness area [PRE]. North West: *Louw 1061*, Witkop, Potchefstroom [J]; *Welman 577*, between Rustenberg & Derby [PRE]; *Louw 724*, Boskop, Potchefstroom [PRE]; *van Wyk 2198*, near Wolmaranstad [PRE]. Gauteng: *Mogg 20332*, Waterval Kloof [J]; *Thode A1328*, Heidelberg [NH, PRE]; *van Jaarsveld 1851*, Northcliff [NBG]; *Lucas 73*, Melville Koppies Nature Reserve [J]; *Moss 6625*, Parktown [J]; *HBG (= Gilliland) s.n.*, Krugersdorp [J26874]; *Thode 2774*, Heidelberg [JF, STE]; *Mogg 10304*, Wonderboom [SAM]; *Mogg 21039*, Houtkop, Langerand hills [J, PRE]; *Leendertz 945*, Wonderboompoort [PRE]; *Leendertz 607*, Pretoria koppies [GRA]; *McMurtry 2800 ex JHB Botanic Gardens 2420*, Melville koppies [PRE]; *Repton 1769*, Wonderboom reserve [PRE]. Free State: *du Preez 282*, Helena, Vredefort [BLFU]; *Stam 71*, Sherwood, Clocolan [PRE]; *Zietsman 538*, Excelsior, Korannaberg [PRE]. Mpumalanga: *Rudatis 2626*, Wonderhoek [STE].

4. Gomphocarpus otiocephalus Nicholas & Goyder. *Sp. nov. G. tomentosi et G. fruticosi affinis. Frutex perennis.* ***Caulis*** *parce ramosus, erectus, cavus, partes juniores velutinus, (0.4-)0.75—3m elatus.* ***Folia*** *oppositus, lamina lineare ad anguste lanceolate, (68-)112—153mm longe, 2—8mm late, textura tenuiter, nervatura secundus prominens; petioli 2—5mm longi.* ***Inflorescentia*** *umbelliformis, lateralis nodus procreans, nutans, pedunculis velutinis, 18—37mm longis, bractis caducis.* ***Flores*** *(4-)6 in inflorescentia, rotatis; pedicellis 21—37mm longi.* ***Corolla*** *patens ad reflexus, subviridis, petalis ovatis ad late-ovatis, 10—14mm longis, 5.2—8mm latis.* ***Coronae*** *1.8—2.8mm supra gynostegi collum basin efferens, lobi lateralis compressus, subquadrangulatis, circa longi (4—5.3mm) quam lati (3.2—5.2mm), appendici proximalis cuneiformis, reflexis vel erectis cum margo minute irregularis, cum stylus-apicis planus; brunneo-vinosus.* ***Folliculus*** *solitarius, erectus, hemisphaerius, inflatus, 67—93mm longus, 32—40mm latus.* ***Typus:*** MacDevette 755, *Mazana river, south of river and west of Escom power line [Holo. NH].*

Description: *Habit*: Perennial shrub; with milky latex. *Underground-organ:* Unknown, probably fibrous. *Stems* erect, (0.4-)0.75—3.0m tall, hollow, branched, terete when

mature & ±4mm in diameter, laterally compressed when young, older stems shortly pubescent, younger stems densely covered in white hairs or velutinous. *Leaves* usually opposite, spreading erect, simple, entire, subsessile to petiolate; blade linear to very narrowly lanceolate, sometimes slightly falcate, (68-)112—153mm long, 2—8mm wide, thinly textured, apex acute, base attenuate or tapering, margin entire & revolute, midrib & 2° veins prominent below, adaxial surface almost glabrous, sparsely pubescent to densely pubescent, abaxial surface almost glabrous, midrib pubescent; petioles 2—5mm long, without basal colleters. *Inflorescences* umbel-like, lateral at the upper nodes, more or less pendulous, (4-)6-flowered; peduncles 18—37mm long, velutinous; bracts linear to filiform, pubescent to velutinous, 7—17mm long, 0.6—1.5(-2.5)mm wide, caducous. *Flowers* rotate, green & brown; pedicels, 21—37mm long, velutinous. *Calyx* 5-merous, purple-green, lobes narrow-lanceolate to narrow-ovate, 5—7(-10)mm long, 1.5—2.5mm wide, abaxial surface velutinous, adaxial surface glabrous. *Corolla* 5-merous, more or less divided to base, spreading to reflexed, creamy green, yellowish, dull purple; lobes usually ovate to broadly ovate or almost oblong, rarely elliptic, 10—14mm long, 5.2—8.0mm, apex subacute to obtuse, margins flat to slightly reflexed, fringed with white hairs which are twice as long on the right hand margin than those on the left. *Staminal-corona* in 1-series, produced 1.8—2.8mm above the gynostegial-column base, 5-merous; lobes fused to staminal-curtain below, free above, laterally compressed, subquadrate, or ear-shaped in side view, about as tall (4—5.3mm) as broad (3.2—5.2mm), proximal upper ends produced into falcate, reflexed, erect, wedge or triangular-shaped, ±1mm long, contiguous appendages, which are level with the style-apex, crenulate or frilly along the margin & continuous with the guide-rails on the inner margin, upper margin convexly curved to almost truncate, distal upper end bluntly angled & slighltly lower than the level of the style-apex, outer margin (= keel) convexly curved or more or less straight, with a small heel-like projection near the base which is produced into a basal horizontal ridge or guide-rail that runs the length of the basal part of the side of the lobe, inner margin with a large vertical wing-like guide-rail, sinus a narrow, sometimes shortly produced, central channel that often has a central ridge running the length, purple brown, chocolate brown, red-brown to brownish purple. *Staminal-column* cylindrical, 6.0—7.0(-7.8)mm tall. *Stamens*: Anther–wings vertical & downwardly beaked at the basal outer point or more or

less truncate, 2.2—2.8mm long, 0.8—1.0mm wide; anther–appendages suborbicular or semicircular, 0.8—1.2mm long, 1.8—2.0mm wide, apex obtuse & often emarginate, membranous, reflexed onto the style-head margin. *Pollinaria*: Pollinia solitary, pendulous in each anther-sac, obliquely subclavate, 1.4—2.0mm long, 0.6—0.8mm wide; translator–arms short but flat & broad, once bent, free part 0.2—0.3mm long, 0.05—0.08mm wide, attached to the upper inner apical margin of the pollinium; corpusculum ellipsoidal, usually with small lateral membranous wings, 0.6—0.8mm long, 0.2—0.3mm wide. *Gynoecium:* Carpels densely covered in papillae. *Style-apex* truncated with a small central depression, 3—4mm in diameter. *Follicles*: Solitary by abortion, erect, hemispherical with inner margin straight & outer margin round, inflated, 67—93mm long, 32—40mm wide, apex short, pointed & reflexed towards the stem, base rounded, surface with a dense covering of echinate purple colored bristles (8-)10—15mm long & velutinous, pedicels recurved in fruit. *Etymology*: From the Greek, *otion–* (= ear) and *–cephale* (= head), in reference to the ear-shaped corona-lobes that adorn the gynostegial-column (fig. 8).

Discussion: Specimens of this new species have remained hidden within herbaria for sometime erroneously being determined as *G. decipiens*. Although similar to this taxon and to *G. tomentosus*, especially in its velutinously haired younger parts, it differs in its habit, flower size, corona-lobe shape and follicle structure. Differences are outlined in the table below:

Table 2: Comparison of *G. tomentosus, G. otiocephalus* and *G. fruticosus* var. *decipiens*.

Character	***G. otiocephalus***	***G. tomentosus***	***G. fruticosus* var. *decipiens***
Habit	1 to several stems sparingly branched high up	1 to several stems sparingly branched high up	Fruticose. Many stems from near the base'
Flowers per nflorescence	(4-)6-flowered	3 to 7-flowered	4 to 6-flowered
Peduncle length	18 to 37mm	12 to 25mm	12 to 25mm
Pedicel length	21 to 37mm	12 to 25mm	19 to 30mm
Sepal length	5 to 8(-10)mm	3.8 to 4.5mm	±6.8mm
Petal length	10 to 14mm	7.8 to 9.0mm	6.8 to 9.0mm

Gynostegial-colum stipe length	1.8 to 2.8mm	±1.0mm	1.0 to 1.7mm
Corona-lobe shape	Subquadrate (as tall as broad)	D-shaped	Subquadrate (taller than broad)
Corona-lobe length	4.0 to 5.3mm	3.4 to 3.8mm	3.4 to 4mm
Corona-lobe width	3.2 to 5.2mm	2.8 to 3.4mm	2.0 to 3.4mm
Upper proximal ends	Produced into reflexed or erect wedge-like or triangular appendages with crenulate margins	Blunt or slightly produced but erect with margin smooth or slightly irregular	Produced into reflexed teeth-like appendages
Upper margin	Curved or almost truncate	Curved & sloping downwards	Truncate
Upper distal end	Blunt but slightly angular & slightly lower than the style-apex	Round & much lower than the style-apex	Angular & level with the style-apex
Follicle shape	Hemispherical, inner margin straight outer margin round	Ovoid lanceolate, often with the inner margin slightly less curved than the outer	Ellipsoid to ellipsoid-ovoid
Follicle width	32 to 40mm	±20mm	20 to 30mm
Follicle apex	obtuse & apiculately beaked	Tapering into a long attenuate beak	Abruptly contracted into a stout beak

In many ways *G. otiocephalus* seems almost intermediate between *G. tomentosus* and *G. fruticosus* var. *decipiens*, but the larger flowers and fruit shape and size not being intermediate are not consistent with the notion of hybridization. The follicle structure is unique amongst the southern African species, but is exhibited by species further north in Africa (fig. 8). Plants are occasional in semi-deciduous bush or woodlands, or in open grasslands. Said to be rare to locally common. Flowering occurs between November and

Janauary, and fruiting between January and March. *G. otiocephalus* is found at altitudes of 800 to 1100 meters.

Distribution: South African endemic. KwaZulu-Natal province only (fig. 3).

Conservation status: Low Risk (Least Concern). Given the fact that the grassland biome of Kwazulu-Natal is under threat from agriculture and aforestation, this species which is of limited distribution and found in small populations, must be considered vulnerable and its long term survival is doubtful.

Representative Specimens: South Africa: KwaZulu-Natal: *West 1807*, near Colenso, Weenen District. (flowers & fruit) [NH]; *Haygarth s.n.*, Zululand. (fruit only) [NH 15935]; *Without collector, number or locality.* (fruits only) [NH 5486]; *MacDevette 2148*, Mtunzini gorge, Itala Nature reserve [NH]; *Williams 103*, Itala Nature Reserve [NH]; *Cunningham 894*, Rondspring farm, near near Paulpietersburg [NU]; *Jordaan 2074*, Mtunzini river, Itala Nature Reserve [NH]; *Williams 63*, Goudhoek farm, Babanango [NH]; *Green 496*,van der Merwes Kraal, Estcout district [NH]; *Tinley 760*, Cwaka stream [NU]; *MacDevette 755*, Monzana river [NH].

5. ***Gomphocarpus tomentosus*** Burch., Travels 1: 543 [1822]. **Type:** *Burchell 2024*, South Africa, Northern Cape province, Asbestos Mountains near Kloof village (29°15'S 23°46'E), 16 Feb. 1812 [Holo. K].

Gomphocarpus fruticosus (L.) R. Br. var. *tomentosus* K. Schum. in Engl. Pfl. Ost.-Afr. C:322 [1895]. **Type:** As above.

Gomphocarpus lanatus E. Mey., Comm. Pl. Afr. Austr.: 202 [1838]. **Types:** *Drège s.n.*, '*Gomphocarpus lanatus* EM. a.', South Africa, hills near Hamerkuil, in rough grasslands, 914—1067m. [Lecto. K; Isolecto. B† BM]. Designated here. *Drège s.n.*, '*Gomphocarpus lanatus* EM. b.', South Africa, Between Buffalo River & Camdeboosberg in Uitvlugt, 1069—1219m. [Isosyn. B† K (fragment)].

Asclepias lanata (E. Mey.) Druce, in Bot Exchange Club of the British Isles 1916: 605 [1916]. **Types:** As for *G. lanatus*.

Asclepias burchellii Schltr., in Journ. Bot. 33: 336 in notes [1895]. **Type:** As for *Gomphocarpus tomentosus*.

Discussion: This species and *Gomphocarpus decipiens* were sunk under *G. fruticosus* by Bullock (1952). However, both these taxa differ in being extremely hairy, less widespread, less weedy and of slightly different habit. As already discussed, *G. decipens* is best treated as a variety under *G. fruticosus*. However, *G. tomentosus* differs from *G. fruticosus* and *G. fruticosus* var. *decipens* in having a slightly different habit, different corona-lobe shape and color, differently shaped fruit and more velutinously haired nature. Because of this, and because there is no evidence of hybridization with *G. fruticosus*, we have decided to continue to treat *G. tomentosus* at specific rank. Huber (1967) also suspects that this species was distinct, and it has subsequently been treated as such by Bruyns (1995). Unlike *G. fruticosus* var. *decipens*, *G. tomentosus* is found predominantly in the central and western half of the subcontinent, although it does make its way into Mozambique and KwaZulu-Natal. These easterly specimens have much smaller and differently coloured flowers, and are less velutinous. These easterly specimens more nearly approach *G. fruticosus* var. *decipiens*. *G. tomentosus* can be distinguished from all other species of southern African of *Gomphocarpus*, except *G. otiocephalus*, by its D-shaped corona-lobes which do not possess reflexed falcate apical upper proximal appendages; they also often do not equal the style-apex in height. Excluding the more easterly distributed specimens, the corona-lobes of *G. tomentosus* usually dry very dark in herbarium specimens. For the differences between this species and *G. otiocephalus* see under that species. *G. tomentosus* is also similar to *Gomphocarpus frederici* (Hiern) Bullock, but this species has inflated follicles and stems more lanate. There is no evidence to support Bullock's opinion (1952) that it is a hybrid between *G. physocarpus* and *G. fruticosus*. According to Rodin (9006 housed at PRE) in Ovamboland this species is known in the Kwanyama language as *omupia* or *etuampia*. Apparently, if cows die from unknown causes, this plant is cooked with the meat to prevent illness in humans that eat it. Dried stems and leaves are roasted, ground into powder and put onto siphilitic and other types of sores. *G. tomentosus* is found growing in grasslands in open woodlands (such as *Acacia-Bothusanthus*) or bushveld (such as *Combretum-Terminalia*). Flowering occurs almost all year round, except July, but peaks during October to May. Plants can be found at altitudes of between 600 and 1600 meters, occasionally as low as 30 meters.

Distribution: African endemic. Southern African in Botswana, Namibia, South Africa [Northern, North West, Mpumalanga, Free State, KwaZulu-Natal, Western Cape, Eastern Cape & Northern Cape provinces] & Swaziland (fig. 5). Also Angola, Zimbabwe and Mozambique.

Conservation status: Probably threatened in some places only.

Representative Specimens: Botswana: *Smith 1309*, Dindinga Island [PRE]; *Rogers 6542*, Mochudi [GRA]; *Allen 118*, Orapa [J]; *MacDonald 7*, Boteti delta area [PRE]; *Kerfoot & Falconer 102*, Pikwe [PRE]; *Hansen 3047*, Seleke Ranch, Central district [PRE]; *Cole 379*, Mokolodi, near Gaborone [PRE]. **Namibia:** *Wild 5155*, Tsabong [PRE]; *Hanekom 345*, Windhoek [PRE]; *Rodin 9006*, Oshikango [PRE]; *Dinter 6182*, Zwartans [JF, STE]; *Pearson 8191*, Krai Kleeft, Great Karasberg [GRA, PRE, SAM]; *de Winter 2483*, Between Gobabsis & Sandfontein [NBG]; *van Jaarsveld 2875*, Ogongo Landboukollege [NBG]; *Gillman 85*, Windhoek [SAM]; *Burgoyne 3301*, on road to Sonop Agricultural Station [PRE]. **South Africa:** Northern: *Shackleton 571*, near Klaserie, Phalaborwa district [BLFU]; *Herman 1282*, Buffelshoek farm, Blouberg [PRE]; *van Wyk, Dalgren & Kok 5454*, near Gyani on way to Punda Milia [PRE]; *Clarke 896*, Bokmakierie 40kms south of Messina [PRE]; *van Wyk & Theron 4938*, Vuvha [PRE]; *van Graan & Hardy 551*, Lake Funduzi [PRE]; *Onderstall 1156*, between Louis Trichardt & Punda Maria, near Levubu [PRE]. North-West: *Mogg 8483*, Vryburg district [PRE]; *Rogers 22712*, Schweizer-Reneke [J]; *Peeters, Gericke & Burelli 66*, Kgokgole [J]; *Codd 3727*, Rustenburg [PRE]; *Ubbink 1267*, Potchefstroom [PRE]; *Gubb 19/0*, Vryburg/Schweizer Reineke [PRE]. Mpumalunga: *Buitendag 966*, Wilsonkop, near Hectorspruit [PRE]; *Stalmans 430*, Lekgalameetse nature Reserve [PRE]; *Bredenkamp 1846*, Pilgrims Rest district [PRE]; *Immelman 655*, between Nylstroom & Naboomspruit [PRE]; *du Plessis 229*, Doornkop, Middelburg [PRE]. Gauteng: *Mogg 26285*, Elandsfontein [J]; *Mogg 18273*, Alberton [J]. Free State: *Potts 2372*, Grants Hill, Bloemfontein [BLFU]; *Bayliss 3873*, Luckhoff [NBG]; *Verdoorn 2400*, Fauresmith [PRE]; *Burtt Davy 9482*, Bloemfontein [PRE]; *Groenewald 4*, Bethulie district [PRE]. KwaZulu-Natal: *Tinley 605*, Mkuze Game Reserve [PRE]; *Stephen, van Graan & Schwabe 989*, Jozini-Ubombo [PRE]; *Vahrmeÿer 1054*, Ubombo [PRE]; *Forbes 745*, Melmoth [NH]; *Ward 386*, Lake Sibayi's [NH, UDW]; *Lawn 1324*, Melmoth [NH];

Pooley 1275, Ndumu Game Reserve [NH]; *McClean 959*, Nkwalini valley [PRE]; *Ward 4148*, Mkuzi Game Reserve [Mkuzi, PRE]. Eastern Cape: *Bolus 378*, Graaff Reinet [GRA, NH, NU, SAM]; *Allardice 1621*, Karoo Nature Reserve, Graaff Reinet district [GRA]; *Archibald 2840*, Vlekpoort Weir, Vlechpoort Conservation Area [GRA flowers & fruit]; *Bayliss 4455*, Graaf-Reinet [NBG, PRE]; *Hall 258*, Chalmers, near Cradock [NBG]; *Burtt Davy 1971*, Cradock [PRE]; *Galpin 9981*, Farm Rietvlei, Pienaar Valley [PRE]; *du Toit 128*, Bergkwagga National Park [PRE]. Northern Cape: *Ward 12436*, Oranjemund, Orange River estuary [NU, UDW]; *Markotter s.n.*, Philipstown [STE 9988]; *Ferrar s.n.*, Kimberley [NH]; *Adams 2*, Warrenton [GRA]; *Moran 7*, Kimberley [GRA]; *Leistner 595*, near Kuruman [NBG]; *Compton 23979*, near Douglas [NBG, STE]; *Wilman s.n.*, Riverton [NBG 98675]; *Moss 10727*, De Aar [J]; *Bryant 923*, Prieska [STE]; *Cooke s.n.*, Ou Maides Kloof [GRA fruit only]; *Lewis 4246*, between Schmidts Drift & Douglas [SAM]; *Retief & Germishuizen 334*, Echodale farm, Hofmeyr district [PRE]; *Hutchinson 3025*, Postmasburg [BOL, PRE]; *Zietsman 816*, Vaalbos, near Barkley West [PRE]. Western Cape: *Gibbs Russell, Robinson & Herman 303*, Beaufort West [PRE, UFH]; *Compton 23913*, Beaufort West [NBG]. **Swaziland:** *Bayliss 566*, without precise locality [PRE].

Surrounding Countries: Angola: *Santos & Barroso 2831*, Baixo Cunene [PRE]. **Zimbabwe:** *Leach & Bullock 13577*, Beitbridge [PRE]. **Mozambique:** *Borle 7*, Tsalala, Maputo [PRE]; *Barbosa & de Lemos 8534*, Inhambane [PRE]; *Mogg 30285*, Inhaca Island [J]; *Mogg 37721*, Inhaca Island [J].

6. *Gomphocarpus Species Nova*.

Discussion: During the process of examining specimens for this revision of *Gomphocarpus* in southern Africa, a number of specimens emerged that were clearly allied to *G. tomentosus* and *G. fruticosus* var. *decipens*, but which differed from these in its corona-lobe shape. In these specimens, cited below, the corona-lobe is sac-like, with the upper margin truncated sinuate and level with the style-apex. Unlike *G. fruitcosus*, these corona-lobes have no recurved dentate appendages at the upper proximal edges, or upwardly directed broad frilly projections as in *G. physocarpus*. Like these species,

however, the keel is truncate and at right angles to the upper margin. In this feature this new species is unlike *G. tomentosus* and *G. otiocephalus* in which the keel is D-shaped and the upper distal margin is curved. We are not the first to notice the differences of this taxon, however, as N.E. Brown saw one of these specimens (*Rogers 6542*) after the completion of his revision in both **Flora Tropical Africa** and **Flora Capensis**. On the *determinavit* label of this specimen he has written "*Asclepias*, appears to be a new sp. allied to but distinct from *A. burchellii*, Schltr." In vegetative, inflorescence and follicle structure this new taxon is exactly like *G. tomentosus*. Strangely, despite its fairly wide distribution not many specimens have been collected. Plants flower from December to May and occur at altitudes of between 300 and 775 meters.

Distribution: Southern Africa endemic. Botswana, South Africa [Northern province only] and Swaziland (fig. 3).

Conservation status: Uncertain, not enough data available.

Representative Specimens: Botswana: *Rogers 6542*, Bochudi [J]. **South Africa:** Northern Province: *Netshiungani s.n.*, Raliphaswa [J]; *Hemm 826*, Messina [PRE]. **Swaziland:** *Karsten s.n.*, Siensha, Stegi district [PRE].

7. ***Gomphocarpus rostratus*** (N.E. Br.) Bullock, in Kew Bull. 7: 410 [1952]. **Types:** *Lugard 22*, Botswana, Lake Ngami, growing on dry shore of the lake or river [Lecto. K (sheet with label in top right hand corner & shoot bearing both flowers & fruit). Isolecto. K]. Designated here. *Lugard 231*, Botswana, Okovanaga basin, 914m. [Isosyn. K, GRA]; *Baum 500*, Angola, Amboella, between Kubango & Kuito rivers [Isosyn. K].

Asclepias rostrata N.E. Br., in Fl. Trop. Afr. 4(1): 331 [1902]. **Types:** As above.

Discussion: Although similar to *G. fruticosus*, *G. rostratus* differs by being less fruticose, in fact, in habit it is more similar to *G. physocarpus*. However, it can be separated from these species (and from most other southern African *Gomphocarpus* species) by the fact that its follicles are neither inflated nor echinate. Bullock (1952) treated *Gomphocarpus stenophyllus* Oliv., as conspecific with this *G. rostratus* but the two, differing in corona and follicle structure, are quite distinct. Plants grow in grasslands, open woodlands, along river and lake banks, in floodplain sands and in shallow pans; listed as a rheophyte by van

Steenis (1981). Found at altitudes from 900 to 1000 meters and flowering from September to July. See also Bruyns 1995 for comments on this species in Namibia.

Distribution: African endemic (centered around the the Caprivi Strip). Southern Africa in northern Botswana and Namibia (Caprivi Strip only) (fig. 7). Also found in Angola and Zambia in regions adjacent to the Caprivi Strip.

Conservation status: Uncertain, but probably with many localized populations threatened.

Representative Specimens: Botswana: *Biegel, Pope & Russell 4016*, island in Zibadianja Lagoon [PRE]; *Gibbs-Russell 2419*, Linyati river at Shaile [PRE]; *Lambrecht 92*, Karangane, near Nokaneng [PRE]; *Smith 644*, Ngandinxeya island [PRE]; *Edwards & Ward 4511*, Kachikau area [NU, PRE]; *Gibbs Russell 2419*, Linyanti river at Shaile [PRE]; *Ellery 270*, Godikwe Island [J]; *Story 4757*, Seronga district, Okavango river [PRE]; *Wild & Drummond 7122*, Between Gomare & Nokaneng [PRE]; *Williamson 54*, Northern district [PRE]; *Cole 909*, Okavango Delta [PRE]; *Ngoni 435*, Toromoja, Batletle river [PRE]; *Banks 74*, Ikoga, Okavango Swamps [PRE]; *Lent 38*, Moreni Game Reserve [PRE]; *Biggs M755*, Mborogha flood plain [PRE]. **Namibia:** *Dinter 4511*, near Shaile Camp [PRE]; *Killick & Leistner 3153*, Linyanti, Zipfel, east Caprivi [PRE, WIND]; *de Winter & Marais* 5037, Fontein Omuramba near Rundu [PRE, WIND]; *Vahrmeijer 2160*, Eastern Caprivi, Sangwali [PRE].

Surrounding Countries: Angola: *Codd 7490*, Mashi river near Shangombo [PRE].

8. Gomphocarpus filiformis (E. Mey.) Dietr., Syn. Pl. 2: 900 [1840]. **Type:** *Drège 892*, South Africa, on plane near Zwartbulletjie, 762m. [Holo. B† Iso. BM (fragmen), K (2 sheets)].

Lagarinthus filiformis E. Mey. Comm. Pl. Afr. Austr.: 203 [1838]. **Type:** As above.

Asclepias filiformis (E. Mey.) Benth. & Hook.f., Gen. Pl. 2: 753, 754 [1876], non Jacquin [1760] nec L.*f*. [1781], *nom. inval.* (combination not written explicitly).

Asclepias filiformis (E. Mey.) O. Kunze, in: Jahrb. Königl. Bot. Gart. Berlin 4: 268 [1886], non Jacquin [1760] nec. L.*f*. [1781]. **Type:** as above.

Asclepias buchenaviana Schinz., Verhandl. Bot. Vereins Brandenburg 30.: 261 [1888]. **Type:** *Schinz 166*, Namibia, Namib, Hereroland, Aug. 1886 [Lecto. Z. Isolecto. K (2 sheets, numbered 18 & 20)]. Designated here. *Lüderitz 125*, Namibia, Namib, Hereroland [Isosyn. Z]; *Stapf s.n.*, Namibia, Namib, Hereroland [Isosyn. Z].
Lüderitz [*n.v.*].

Asclepias filiformis (E. Mey.) Benth. & Hook.*f*. var. *buchenaviana* (Schinz) N.E. Br., in Fl. Trop. Afr. 4(1): 336 [1902]. **Type:** As for *Asclepias buchenaviana.*

Asclepias flagellaris Bolus ex Schltr., Bot. Jahrb. 18(5). Beibl. 45: 32 [1894] & Bot. Jahrb. 21(5). Beibl. 54: 7 [1896], *nom. nov.* for *Asclepias filiformis* (E. Mey.) auct., non Jacq. [1760].

Discussion: This is a very distinctive species with a much branched habit from ground level, almost leafless stems and, when present, very small narrow filiform leaves. *G. filiformis* grows in very arid situations, often more or less abundant in dry river beds. This species is similar to *G. tenuifolius* and *G. stenophyllus* in its rostrate, smooth follicles with semi-membranous pericarp (Bullock, 1953b), this characteristic it also has in common with *G. rostratus*. Unlike other species in southern Africa *G. filiformis* has a horn-like appendage in the sinus cavity. Brown (1904) divided this species into two varieties, the type and var. *buchenaviana* (Schinz) N.E. Br. based on the possession of stouter and usually white and waxy stems, and slightly different corona-lobe morphology. This varietal division has not been followed by Bullock (1953b) and we have decide not to do so either; although more detailed studies may indicate otherwise. We have chosen *Schinz 166* as the lectotype of the name *Asclepias buchenaviana* as this sheet is the only one that combines all the following elements: the name *A. buchenaviana* (as opposed to *A. filiformis*), the locality 'Namib, Hereroland' and the diagnostic fused tooth in the corona-lobe cavity. The Kew sheets match the gross morphology and form of the corona; they also bear the data '*Asclepias buchenaviana* Schinz, Namib, Hereroland, Schinz, received April 1888', but are numbered 18 and 20. As a result, we believe it reasonable to assume that they are duplicates of the Zurich speciomen. The occurence of *G. filiformis* in Namibia is discussed by Bruyns (1995). The corolla is usually yellowish green and the corona white. Plants are found at altitudes of between 460 and 1370 meters and flowering occurs from September to May rarely as late as July. Plants occur in semi-desert to desert

areas, in the karoo and succulent succulent-karoo, and are often found in dry river beds, on river banks, in dongas, or occasionally in disturbed areas (fig. 8). It may occur in a wide variety of soils from gravel to sand to loam and even clay.

Distribution: Southern African endemic. South Africa [Western & Northern Cape provinces only] and Namibia (fig. 7).

Conservation status: Unknown, but probably not at risk as it grows in dry, inhospitable areas unsuitable for human exploitation.

Representative Specimens: Namibia: *Brink 572*, near Welwitschia flats [GRA]; *Abbott s.n.*, Welwitschia flats [NU]; *Goldblatt 1870*, near Grunau [PRE]; *van Wyk 8582A*, Karasburg [PRE]; *Dinter 2809*, Welwitschia flats [SAM]; *Rogers 29646a*, Keetmanshoop [GRA]; *Roux 226*, near Swakopmund [NBG]; *Pearson 3871*, near Bitterfontein [BOL, GRA]; *Brusse 4272*, near Keetmanshoop [PRE]; *Ihlenfeldt 1926*, Kleins Namib-river, near Swakop [PRE]; *Ward 12733*, Karasburg, near Grunau [NU]. **South Africa:** Northern Cape: *van Jaarsveld s.n.*, Pofadder [JF, PRE, STE with photograph]; *Comins 1078*, near Richmond [GRA, PRE]; *Bolus 640*, Riet Vley [BOL, NH, GRA, SAM flowers & fruit]; *Zeyher 1167*, between Lospers Plaats & Springbok Kuil [BOL, JF, SAM flowers & fruit, STE, TCD]; *Hugo 379*, Sak River near Brandvlei [PRE, STE]; *Leistner 2364*, Kenhardt [PRE]; *Burger 116*, Kalkgat farm, Bookeveld Mountains [PRE]; *Theron 1631*, Williston [PRE]; *Leistner 3361*, Pofadder [PRE]; *Germishuizen 6384*, Karee Kop, Williston district [PRE]. Western Cape: *Gibbs Russell, Robinson & Herman 516*, foot of Neweveld mountains [GRA, PRE, UFH]; *Gölcher s.n.*, Retreat, Laingsburg [STE 10109 flowers & fruits]; *Pillans 16315*, Prince Albert [SAM]; *Compton 10398*, Prince Albert district [NBG]; *Bayliss 1965*, Prince Albert [NBG]; *Barker 8856*, Beaufort West [NBG]; *Burke 247*, near Gamka River [SAM]; *Cattell & Cattell 222*, Gamka-Poort Nature Reserve [STE]; *Theron 1300*, Beaufort West [Pre with photo]; *Stirton 7208*, near Kruidfontein [PRE]; *Hartman 1925*, Vanrhynsdorp district [PRE]; *Bayliss B5/1176*, Touws' River [PRE 2 sheets]; *Ward 1043*, near Beaufort West [NU]. **Without Precise Locality:** *Ecklon & Zeyher 130* [TCD].

9. Gomphocarpus cancellatus (Burm. *f.*) Bruyns, in Bothalia 25(2): 165 [1995]. **Type:** Figure 13 (*Apocynum frutescens, latis and undulatis foliis; floribus umbellatis, frutu gemino sulcato, spinoso*) in: Burmann, J. Rariorum Africanarum Plantarum. t, 13 [1738] [Lectotype]. Designated here.

Asclepias cancellatus Burm.*f.* Prodr. Cap.: 7 [1 March - 6 April 1768]. **Type:** As above.

Gomphocarpus cancellatus (Burm.*f.*) Nicholas & P.I. Forster, in Fl. Australia 28: 319 [1996]. *Comb. superfl.*

Asclepias rotundifolia Miller, Gard. Dict. ed. 8: n°. 15 [16 April 1768]. **Type:** [*n.v.*]. Not traced.

Asclepias pubescens L., Mantissa Altera: 215 [1771]. **Type:** *Without collector & number*, in Linnean Herbarium [Holo. Linn 310.5].

Asclepias arborescens L. Mantissa Altera: 216 [1771]. Figure 13 (*Apocynum frutescens, latis and undulatis foliis; floribus umbellatis, frutu gemino sulcato, spinoso*) in: Burmann, J. Rariorum Africanarum Plantarum. t, 13 [1738] [Lectotype]. Designated here.

Gomphocarpus arborescens (L.) Ait. *f.*, Hort. Kew. edn 2, 2: 79 [1811]. **Type:** As above.

Asclepias arborea Salisb. Prodr.: 150 [1796]. **Type:** As for *Asclepias arborescens*

Asclepias vestita Hook., in: Bot. Mag. t. 4106 [1844] non Hook. & Arn. [1841]. **Type:** 'Hort. Kew v. Bot. Mag. 1844' [Holo. K].

Discussion: This species has a number of interesting nomenclatural problems. The *Asclepias cancellata* of Burman *filius* was published between the 1st of March and 6th of April 1768, and so just predates the *Asclepias rotundifolia* of Miller which was published on the 16th of April 1768. Burman *f.* makes no reference to type material, but cites two figures given by his father in *Rariorum Africanarum Plantarum*. Figure 14 is a mixed plate containing *G. cancellata* and *Periploca africana*. Figure 13 is the better plate and has been choosen as the type. The specimen in Linnaeus' herbarium labelled *Asclepias cancellata* [LINN. 310.31] is actually a specimen of *Schizoglossum*. According to Savage's list (1954) SW deted the specimen as *Asclepias arborescens*. James Smith questions this decision in writing on the specimen. As a result, we may never know what

Linnaeus' concept of *Asclepias arborescens* was and we have decided due to the confusion outlined above to treat it as a *nomen confusum*.

G. cancellatum is found in the winter rainfall region of South Africa and is generally an inhabitant of the Succulent Karoo biome. It is especially common in the Western Cape province, where it is often found in disturbed areas especially along roadsides. It is apparently more rare in the Northern Cape province and Namibia (Bruyns, 1995). Plants are found growing in sand, talus, stony ground or even in clay. It flowers all year round but peaks between about July and March, and occuring at altitudes of between 20 to 1400 meters. *G. cancellatus* found its way into cultivation in Europe as early as 1714 when it was grown by the Dutchess of Beaufort. (Aiton,1811). Since then it has also been introduced into Australia where it has become naturalized on roadsides and rocky hillsides in South Australia and Victoria (Forster, 1996). Lazarides & Hince (1993) also mention that in this country it has become a laval food plant for the Wanderer butterfly. *G. cancellatus* is a very distinctive species which can be distinguished by the fact that it usually only has one to a few stout stems branching from the base and ovate shaped coriaceous leaves with a shiny surface. The fruit, being large and leathery, resembles those *Pachycarpus*, but differs from this genus in the surface being covered in short, stout spines; in this it approaches *Xysmalobium stockenstromense*. Peter Green (previously Kew) in a note in Bolus Herbarium also mentions this species similarities to *Calotropis*, viz., its ovate leaves, flowers crowded in umbels, spiky follicles and hairy stems. Any resemblence between this species and *Calotropis*, *Pachycarpus* and *Xysmalobium* is either due to convergence or genes from a common ancestory. In its sometimes solitary stems, and glaucous waxy broadly ovate leaves with prominent 1° and 2° venation, and base sometimes hastate and clasping the stem, this species resembles *G. glaucophyllus* subgenus *Leiocalymma*. However, it does not fit into this subgenus because of its fibrous rootstock, and inflorescence and flower structure. As a result, we have opted to keep it in subgenus *Gomphocarpus*, even though its unusual facie and fruit structure could justify the erection of another subgenus, or a separate section under subgenus *Gomphocarpus* (fig. 6). *G. cancellatus* contains an alkaloid which has been regarded as a substitute for quinine (Watt & Breyer-Brandwijk, 1962).

Figure 6. *Gomphocarpus rivularis*: a. Habit (*circa* 2 meters); b. Branch with flowers. *Gomphocarpus cancellatus*: c. In roadside habitat (1.4 meters tall); d. In fynbos grassland habitat (0.8 meters tall); e. With flowers; f. close up of flowers; g. With fruit; h. Close up of fruit. Photographs: a & b by T. Coleman; c to h by A. Nicholas.

Distribution: Southern African endemic. Namibia and South Africa [Northern Cape, Western Cape & Eastern Cape provinces] (fig. 7).

Conservation status: Plant with weedy propensities. Not yet of conservation concern.

Representative Specimens: Namibia: *Abbott s.n.*, Swakop river, Welwitschia park [NU 54144]. **South Africa:** Northern Cape: *Nicholas 2480*, near Nababiep [PRE]; *van Wyk 6348*, Namaqualand [PRE]; *Whitehead s.n.*, Modderfontein [TCD]; *Wisura 3008*, Springbok [NBG]; *Compton 11084*, Brakdam [NBG]; *Story 4410*, Lokenburg near Niewoudville [PRE]; *PC & L Zietsman 700*, 20kms south of Springbok [PRE]; *Werdermann & Oberdieck 608*, Namaqualand [PRE]; *Marloth 12675*, Klipfontein mountain, Steinkopf [JF, PRE]. Western Cape: *MacOwen 320*, Eastern districts [TCD]; *Walters 1266*, Bain's Kloof [NBG]; *Hanekom 499*, Skoongesig, Ceres [BLFU]; *Boucher 4463*, Blydskap farm, Paardeberg [JF, PRE, STE]; *Walters 718*, Sandhills [NBG]; *Viviers 356*, Meiderif, Algeria Forest Station [JF, STE]; *Compton 20568*, near Nuwerus (Nieuwerust) [NBG]; *Compton 19470*, Pakhuis Pass [NBG]; *Taylor 4734*, Seweweekspoort, Swartberg Forest Reserve [JF, PRE, STE]; *Thode 2265*, Cape Peninsula [STE]; *Fellingham 437*, Rooiberg [PRE]; *Forsyth 117*, Cedarberg State Forest [STE]; *Zeyher s.n.*, near Olifontsrivier [SAM 18549]; *Bayliss 2245*, Touws River [NBG]; *Middlemost 1705*, Garcias Pass [NBG]; *Purcell s.n.*, Caledon district [SAM 46229]; *van der Merwe 2556*, Vrolijheid Nature Reserve [PRE]; *Theron & van der Schijff 2022*, Swartberg, Oudtshoorn [PRE]; *Bond 1734*, Jonkersberg, Outeniquas [JF, PRE]; *von Breitenbach 1073*, Geelhoutboomberg, George [PRE]; *Kerfoot 5325*, Jonkershoek, Stellenbosch [JF, PRE]; *Smith 4311*, Bredasdorp [PRE]; *Rogers 13543*, Redhill, Simonstown [PRE]; *Schlieben 10237*, Swellendam [PRE]; *Theron 2063*, Tulbagh [PRE]; *Esterhuysen 33536*, Jonkershoek [BOL]. Eastern Cape: *Bayliss 8728*, Highlands Road, Albany [GRA]; *Jacot Guillarmod 7990*, near Stonehaven Hall [GRA]; *Long 370*, Atherston [PRE]; *Dyer 1595*, Dr Schonland's Farm, Albany [GRA]; *Glass 348*, Grahamstown [NBG]; *Bolus 469*, Graaff Reinet [SAM]; *Story 3887*, near Highlands [PRE]; *Henrici 5014*, Graaf Reinet district [PRE].

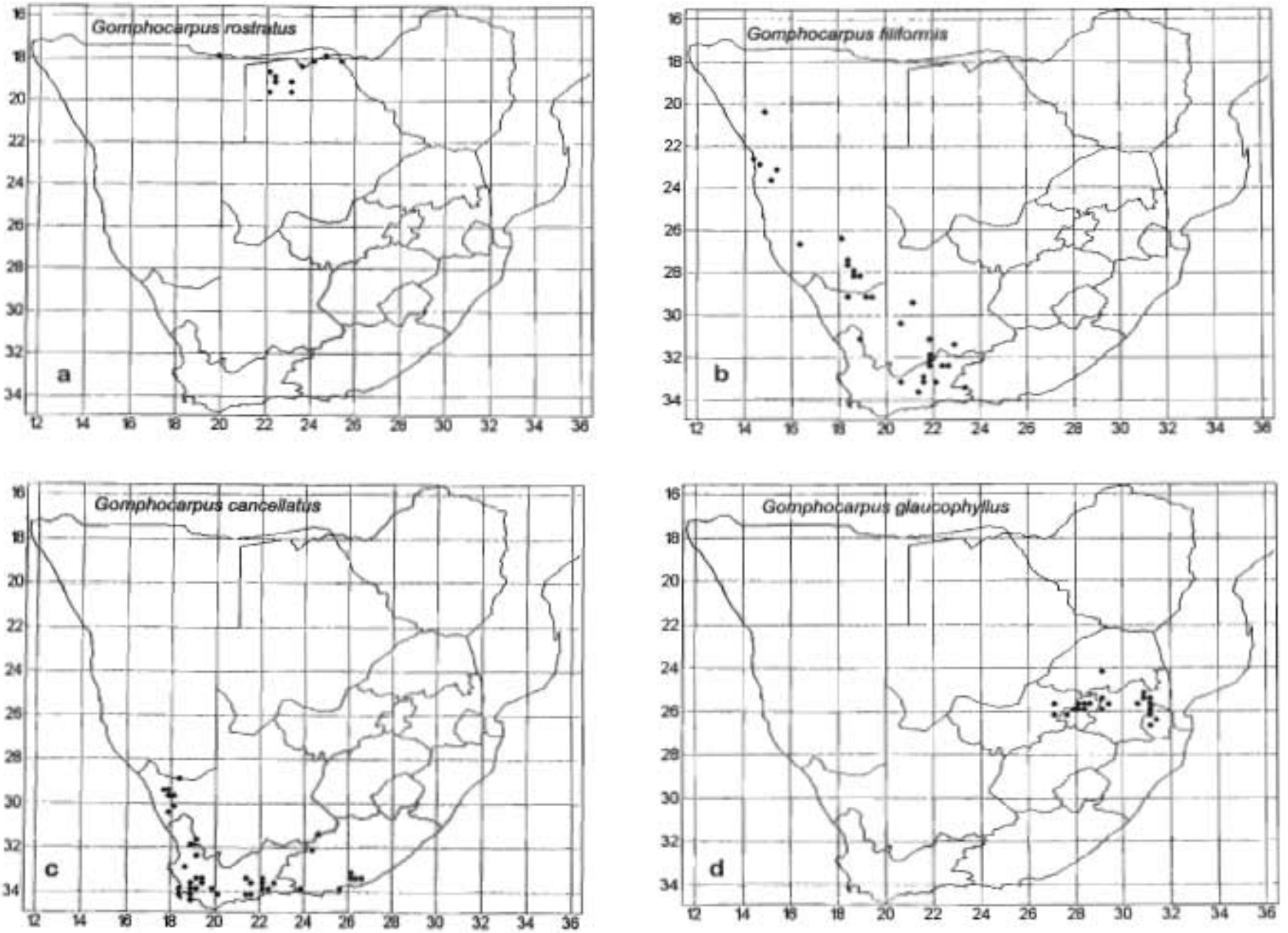


Figure 7. Distribution of: a. *Gomphocarpus rostratus*, b. *G. filiformis*; c. *G. cancellatus* and; d. *G. glaucophyllus*.

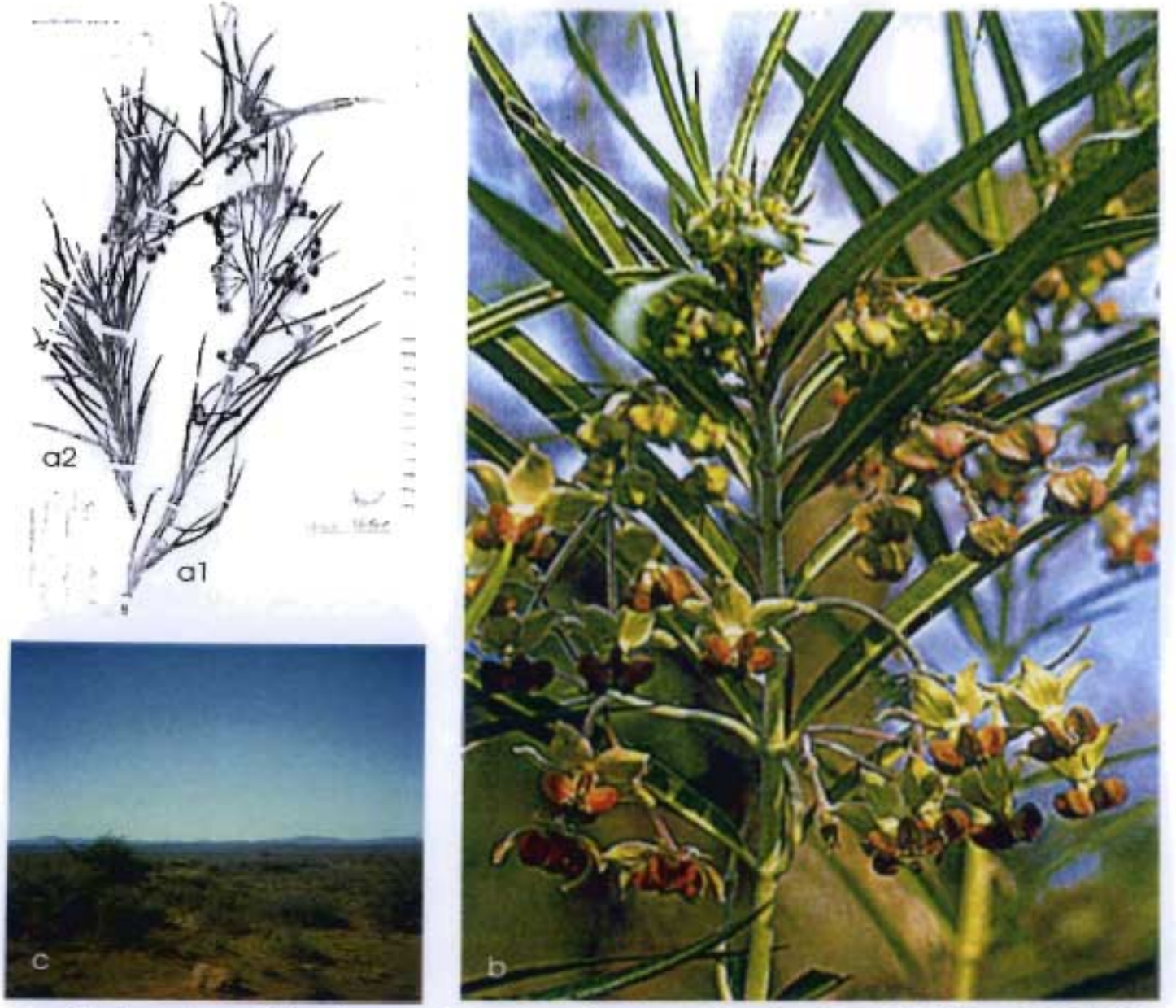


Figure 8. a. Isosyntypes of *Gomphocarpus fruticosus* var. *decipiens*, a1. Leendertz 617, a2. Schlechter 3589 (BOL); b. Flowering stem of *G. otiocephalus*; c. Landscape west of Poffader showing habitat of *G. filiformis*. Photographs: a & c by A. Nicholas, b by G. Nichols

GOMPHOCARPUS Subgenus ***LEIOCALYMMA*** **Goyder & Nicholas,** *subgen. nov.* ***Herba*** *perennis crassas.* ***Radicis*** *probabiliter caudex crassus lignosus.* ***Caules*** *3—4, simplices, 300—900mm elatis, 6—12mm crasses.* ***Folia*** *sessiles vel subsessilo, 30—150mm longi, 18—63mm lati, elongato ovati, apicibus acutis, basin cordate, caules amplectentes.* ***Inflorescentia*** *extra-axillaris, nutans, pedunculis 25—50mm longis.* ***Flores*** *in quoque inflorescenta 6—15, pedicello 18—35mm longo.* ***Corolla*** *reflexa vel rotato-campanulate, albe.* ***Corona-lobis*** *saccatis, longioribus latis, apicem gynoecii aequans.* ***Antherae appendices*** *ovatae et obtusae.* ***Gynoecium:*** *apex applanatus.* ***Fructus*** *fusiformis, circa 90mm longus, circa 19mm crassus, laevis, cum circa 6 alis angustis marginibus integris vel irregularibus.* ***Typus subgeneris****: Gomphocarpus glaucophyllus Schltr., vide infra.*

Gomphocarpus E. Mey., section *Eugomphocarpus* Decne., subsection *Leiocalymma* K. Schum., in Engler & Prantl. Pflzfam. 4(2): 236 [1895]. **Type species:** *Gomphocarpus glaucophyllus* Schltr., Selected here.

Description: *Habit*: A stout perennial herb, essentially glabrous; with milky latex. *Rootstock*: Probably a stout woody stem-tuber. *Stems* 3—4 to a plant, unbranched, 450—915mm tall, 6—12mm thick, glabrous to bifariously puberulous. *Leaves*: spreading ascending to ascending, sessile to subsessile; lamina elongate-ovate, cordate to cordate-oblong, 30—155mm long, 18—65mm broad, glaucous, green to bluish green, apex acute, subacute to obtuse, base cordate to subamplexicaul & clasping the stem; margins flat, smooth & entire, glabrous on both side. *Inflorescences*: Produced lateral at the nodes, pendulous, 6—15-flowered; peduncles slender, 25—50mm long; bracts linear to filiform, 3.4—9.0mm long, ±1mm wide. *Flowers* white, creamy green or yellowish green. 15—20mm in diam., reflexed-rotate to rotate-campanulate; pedicels 18—35mm long. *Sepals*: oblong, 5.6—6.8mm long, 2.2—3.4mm wide, apex subacute to obtuse, glabrous to minutely ciliate. *Corolla* greenish white; lobes elliptic to elliptic-ovate, 9—14mm long, 6—9mm broad, divided almost to base, apex subacute, margins ciliolate to ciliate. *Staminal-corona* decurrent or arising 0.5—1.0mm above the gynostegial-column base, 5-merous; lobes erect, laterally compressed, saccate-cucullate, subquadrate in side view, as broad as long, 4.5—6.0mm long and tall, level with the style-apex; upper proximal ends obtuse to dentate (and then projecting over the style-apex), sinus a slit-like channel; white

to yellowish brown. *Staminal-column* ±5.6mm tall; anther-wings prominent & acutely angled; anther-appendages ovate, apex obtuse, membranous, inflexed over the style-apex. *Style-apex*: truncated. *Follicles*: fusiform or inflated-ovate, 50—90mm long, 19—25mm thick, smooth & with or without about 6 narrow entire or irregularly toothed longitudinal wings, with some of the upper teeth produced into compressed linear obtuse processes 4.5—9mm long. *Etymology*: *Leiocalymma* from the Latin: *Leio-* (= smooth), *calymma* (= covering or veil) in reference to the fact that the corona-lobe sinus is smooth & does not have papillae.

Discussion: This subgenus can be distinguished by its almost fleshy, glaucous (blue-green and waxy) stems and leaves. The leaves are large and have a base that is cordate and clasps the stem (a character also seen in *Calotropis* and *Xysmalobium woodii*). Otherwise the inflorescences and flower structure are almost the same as for subgenus *Gomphocarpus*. The only southern African species to fall into this subgenus is *G. glaucophyllus*, but the tropical African species *G. semiamplectans* also belongs here.

Distribution: African endemic. Southern Africa in Namibia, South Africa [Gauteng & Mpumalanga provinces] & Swaziland. Further north to the East African highlands, as far north as Uganda and northern Tanzania.

10. Gomphocarpus glaucophyllus Schltr., in Bot. Jahrb. 18(45):19 [1894]. **Type:** *Galpin 663,* South Africa, Mpumalanga province, Kaap valley near Barberton, Nov. 1889, 792m. [Holo. B† Iso. GRA, K, NH, PRE].

Asclepias glaucophylla (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As above.

Asclepias lilacina Weim., in Bot. Not. 1935: 374 [1935]. **Type:** *Fries, Norlindh & Weimarck 3062*, Zimbabwe, between Inyanga & Rusape, 1800m, 19 Nov. 1930 [Holo. LD].

Discussion: This is a beautiful species which is not often collected. *G. glaucophyllus* shares some common features with *Xysmalobium sensu stricto* (viz. *X. undulatum, X. stockenstroomense* and *X. woodii*) and *Caloptropis*, and may have had a common origin from some distant ancestral group with these genera. Plants grow in grassland which may sometimes be stony, rarely in open woodlands or marshy ground. *G. glaucophyllus*

flowers between August and June, peaking October to January, and occuring at altitudes of between 765 to 1500 meters, rarely up to 1900 meters. The Vhenda apparently cook and eat the young leaves as a type of spinach and call the plant *gunaperi* or *gunatela* (Fox & Norwood Young, 1982). In Afrikaans the plant is known as *bloumelkbos* possibly in reference not only to the milky latex but also the bluish green, glaucous leaves. Illustrated in Fox & Norwood Young (1982). The illustration in Malaise (1985) may be of *G. semiamplectans*.

Distribution: African endemic. Southern Africa in South Africa [Gauteng, Northern & Mpumalanga provinces] and Swaziland (fig. 7). North towards East African highlands as far north as Uganda and northern Tanzania. *de Winter 3881* (WIND in fruit only) from Namibia said by Bruyns (1995) to be this species is probably *Gompocarpus semiamplectens*.

Conservation status: Low Risk (Least Concern). In South Africa this plant occurs in provinces that are extensively exploited or urbanized. If not vulnerable now it probably will be some time in the next century.

Representative Specimens: South Africa: Northern: *Crawley 7158*, Potgietersrust [PRE]. North-West: *Pegler 966*, Rustenburg [BOL fruit & flowers, GRA, NH, PRE]; *Obermeyer 27601*, Uitkomst farm near Scheerpoort [NH]; *Sutton 622*, Goedegedacht [PRE]. Gauteng: *Leendertz s.n.*, Derde Poort [BLFU 883]; *Codd 10135*, Bronkhorstspruit [PRE]; *Prosser s.n.*, Hornsnek, Magaliesberg [J 29347]; *Mogg 26490*, Suikerbosfontein [J]; *Burtt Davy 2570*, Pretoria [NH, PRE]; *Young 1300*, Cullinan [J]; *Phillips 3045*, Pretoria [GRA, PRE]; *Maguire 22874*, Warrenslaagte [J with flower & fruit]; *Moss 13856*, Magaliesberg [J]; *van Rooyen 2038*, Roodeplaat Nature Reserve [PRE]; *Burger 354*, Magaliesberg [PRE]; *Isaacs 283*, Elandshoek, Cullinan [PRE]; *Repton 4692*, Bronkhorstspruit [PRE]. Mpumalanga: *du Plessis 841*, Middelburg [PRE]; *Gilfillan 7214*, Witbank Station [GRA]; *Galpin 633*, Barberton [SAM]; *Edwards 636*, near Barberton on Badplaas road [NU]; *Thorncroft 1029*, Barberton [PRE]; *Theron 1606*, between Verena & Nooitgedacht [PRE]; *Mogg 17565*, Pilgrims Rest [PRE]; *Rogers 20539*, White River [PRE]. **Swaziland:** *Compton 26177*, Malkerns [PRE]; *Rogers 11673*, Mbabane [PRE]; *Braun 1682*, Hhohho district [PRE]; *Burtt Davy 3240*, without precise locality [PRE].

Excluded Species

Gomphocarpus multiflorus Decne., in DC. Prodr. 8: 560 [1844]. *Without locality, collector or collectors number* [Holo. P; *n.v.*].

Discussion: From the description this belongs to *Schizoglossum* and not any of the genera outlined in this paper.

Southern African Names Excluded from Gomphocarpus

G. acerateoides Schltr. = ***Pachyacris acerateoides* (Schltr.) Stweart & Langley ex Nicholas & Goyder**

G. adscendens Schltr. = ***Pachyacris adscendens* (Schltr.) Nicholas & Goyder**

G. affinis Schltr. = ***Pachyacris albens* (E. Mey.) Nicholas & Goyder**

G. alatus Schltr. = ***Pachycarpus dealbatus* E. Mey.**

G. albatus* in error Schltr. = ***Pachycarpus dealbatus* E. Mey.

G. albens* (E. Mey.) Decne. = ***Pachyacris albens* (E. Mey.) Nicholas & Goyder

G. amoenus K. Schumn. = ***Trachycalymma pulchellum* (Decne.) Bullock**

G. appendiculatus (E. Mey.) Decne. = ***Pachycarpus appendiculatus* E. Mey.**

G. arborescens (L.) R. Br. = ***Gomphocarpus cancellatus* (Burm. f.) Bruyns**

G. arborescens (L.) Ait. f. = ***Gomphocarpus cancellatus* (Burm. f.) Bruyns**

G. arborescens sensu Sprenge = ***Xysmalobium undulatum* (L.) Ait.f. var. *undulatum***

G. arenarius Schltr. = ***Pachyacris crispa* (L.) Nicholas & Goyder var. *pseudocrispa* (N.E. Br.) Nicholas & Goyder**

G. asclepiaceus Schltr. = ***Pachyacris hastata* (E. Mey.) Nicholas & Goyder**

G. asper* Decne. = ***Trichocodon linearis* (E. Mey.) Nicholas

G. asperifolius* (Meisn.) Walp. = **Pachycarpus asperifolius Meisn.

G. aureus Schltr. = ***Aidomene aurea* (Schltr.) Nicholas & Goyder**

G. brevicuspis (E. Mey.) Dietr. = ***Bruynsia brevicuspis* (E. Mey.) Nicholas**

G. brevipes Schltr. = ***Aidomene brevipes* (Schltr.) Nicholas & Goyder**

G. campanulatus Harv. = ***Trichocodon campanulatus* (Harv.) Nicholas**

G. carinatum (Schltr.) N.E. Br. = ***Woodia carinatum* (Schltr.) Nicholas**

G. concinnus Schltr. = ***Sigridia concinna* (Schltr.) Nicholas**

G. concolor (E. Mey.) Dietr. = ***Pachycarpus concolor* E. Mey.**

G. corniculatus (E. Mey.) Dietr.= ***Woodia corniculatum* (E. Mey.) Dietr.**

G. coronarius (E. Mey.) Decne. = ***Pachycarpus coronarius* E. Mey.**

G. crispus (L.) R. Br. = ***Pachyacris crispa* (L.) Nicholas & Goyder**

G. cucullatus Schltr. = ***Aidomene cucullata* (Schltr.) Nicholas & Goyder**

G. cultriformis* Harv. = ***Sigridia cultriformis* (Harv.) Nicholas

G. dealbatus (E. Mey.) Decne. = ***Pachycarpus dealbatus* E. Mey.**

G. depressus Schltr. = ***Pachyacris multicaulis* (E. Mey.) Nicholas & Goyder**

G. diploglossus Turcz. = ***Aspidonepsis diploglossa* (Turcz.) Nicholas & Goyder**

G. eminens Harv. = ***Bruynsia eminens* (Harv.) Nicholas**

G. eustegioides Dietr. = ***Schizoglossum crassipes* S. Moore.**

G. expansus (E. Mey.) Dietr. = ***Paulforstera expansa* (E. Mey.) Nicholas**

G. fallax Schltr. = ***Pachyacris fallax* (Schltr.) Nicholas & Goyder**

G. flexuosus (E. Mey.) Dietr. = ***Pachyacris flexuosa* (E. Mey.) Nicholas & Goyder**

G. foliosus K. Schum. = ***Trachycalymma pulchellum* (Decne.) Bullock**

G. fragrans Schltr. = ***Pachyacris flexuosa* (E. Mey.) Nicholas & Goyder**

G. frutescens* Dietr. = ***Gomphocarpus physocarpus* E. Mey.

G. frutescens E. Mey. = ***Gomphocarpus fruticosus* (L.) Ait. f.**

G. fruticosus (L.) Ait. f. var. *tomentosus* (Burch.) K. Schum. = ***Gomphocarpus tomentosus* Burch.**

G. fruticosus sensu* Sim. = ***Gomphocarpus physocarpus* E. Mey.

G. galpinii Schltr. = ***Pachycarpus galpinii* (Schltr.) N.E. Br.**

G. geminatus Schltr. = ***Pachyacris hastata* (E. Mey.) Nicholas & Goyder**

G. geminiflorus Schltr. = ***Pachycarpus concolor* E. Mey.**

G. gerrardii Harv. = ***Trichocodon campanulatus* (Harv.) Nicholas var. *sutherlandii* (Harv.) Nicholas**

G. gibbus (E. Mey.) Dietr. = ***Bruynsia gibba* (E. Mey.) Nicholas**

G. glaberrimus Oliv. = ***Kanahia laniflora* (Forssk.) R. Br.**

G. gracilis Dietr. = ***Schizoglossum exile* (Decne.) Schltr.**

G. grandiflorus (L.f.) Decne. var. *tomentosus* Schltr. = ***Pachycarpus grandiflorus* (L.f.) E. Mey. var. *tomentosus* Schltr.**

G. harveyanus Schltr. = ***Pachyacris prunelloides*** **(Turcz.) Stewart & Langley ex Nicholas & Goyder**

G. hastatus E. Mey. = ***Pachyacris hastata*** **(E. Mey.) Nicholas & Goyder**

G. hastatus E. Mey. var. *angustifolius* Meisn. = ***Pachyacris crispa*** **(L.) Nicholas & Goyder**

G. hispidus Turcz. = ***Schizoglossum aschersonianum*** **Schltr.**

G. humilis (E. Mey.) Decne. = ***Aidomene humilis*** **(E. Mey.) Nicholas & Goyder**

G. insignis (Schltr.) Schltr. = ***Pachycarpus concolor*** **E. Mey. subsp.** ***transvaalensis*** **(Schltr.) Nicholas**

G. interruptus (E. Mey.) Dietr. = ***Aspidoglossum interruptus*** **E. Mey.**

G. involucratus (E. Mey.) Dietr. = ***Woodia involucratum*** **(E. Mey.) Nicholas**

G. lanatus E. Mey. = ***Gomphocarpus tomentosus*** **Burch.**

G. linearis (E. Mey.) Dietr. = ***Trichocodon linearis*** **(E. Mey.) Nicholas**

G. linearis sensu Schltr. = ***Trichocodon campanulatus*** **(Harv.) Nicholas var.** ***sutherlandii*** **(N.E. Br.) Nicholas**

G. longifolius Schltr. = ***Woodia gomphocarpoides*** **(E. Mey.) Nicholas**

G. marginatus Schltr. = ***Sigridia viridiflora*** **(E. Mey.) Nicholas var.** ***viridiflora***

G. marginatus (E. Mey.) Decne. pro parte = ***Woodia mucronata*** **(Thunb.) N.E. Br. var.** ***mucronata***

G. macer (E. Mey.) Dietr. = ***Sisyranthus macer*** **(E. Mey.) Schltr.**

G. mackenii Harv. = ***Pachycarpus mackenii*** **(Harv.) N.E. Br.**

G. macroglossus Turcz. = ***Pachycarpus appendiculatus*** **E. Mey.**

G. macropus Schltr. = ***Pachyacris macropus*** **(Schltr.) Nicholas & Goyder**

G. mackenii Harv. = ***Pachycarpus mackenii*** **(Harv.) N.E. Br.**

G. meliodorus Schltr. = ***Pachyacris meliodora*** **(Schltr.) Nicholas & Goyder**

G. meyerianus Schltr. = ***Aidomene meyeriana*** **(Schltr.) Nicholas & Goyder**

G. multicaulis (E. Mey.) Dietr. = ***Pachyacris multicaulis*** **(E. Mey.) Nicholas & Goyder**

G. multiflorus Decne. = ***Schizoglossum*** **species?**

G. navicularis (E. Mey.) Dietr. = ***Bruynsia navicularis*** **(E. Mey.) Nicholas**

G. ochroleucus Schltr. = ***Pachyacris gerrardii*** **(Scott-Elliot) Nicholas & Goyder**

G. orbicularis (E. Mey.) Schltr. = ***Parapodiopsis orbicularis*** **(E. Mey.) Stewart & Langley ex Nicholas**

G. ovatus Schltr. = ***Pachyacris acerateoides*** **(Schltr.) Stewart & Langley ex Nicholas & Goyder**

G. oxytropis Turcz. = ***Bruynsia gibba*** **(E. Mey.) Nicholas**

G. pachyglossus schltr. = ***Pachyacris parviflora*** **(Harv. ex Scott-Elliot) Stewart & Langley ex Nicholas & Goyder**

G. pachystephanus Schltr. = ***Schizoglossum linifolium*** **Schltr.**

G. padifolius Baker = ***Parapodiopsis orbicularis*** **(E. Mey.) Stewart & Langley ex Nicholas**

G. parviflorus Schltr. = ***Pachyacris sulphrea*** **(S. Moore) Nicholas & Goyder**

G. peltigerus (E. Mey.) Dietr. = ***Paulforstera peltigera*** **(E. Mey.) Nicholas**

G. prunelloides (Turcz.) Schltr. = ***Pachyacris prunelloides*** **(Turcz.) Stewart & Langley ex Nicholas & Goyder**

G. pulchellum Decne. = ***Trachycalymma pulchellum*** **(Decne.) Bullock**

G. rectinervis Schltr. = ***Parapodiopsis confusa*** **(Scott Elliot) Stewart & Langley ex Nicholas**

G. reflectens (E. Mey.) Decne. = ***Pachycarpus reflectens*** **E. Mey.**

G. revolutus (E. Mey.) Dietr. = ***Aidomene revoluta*** **(E. Mey.) Nicholas & Goyder**

G. rigidus E. Mey. var. *tridens* E. Mey. = ***Pachycarpus rigidus*** **E. Mey.**

G. roseus K. Schum. = ***Trachycalymma pulchellum*** **(Decne.) Bullock**

G. scaber harv. = ***Pachycarpus scaber*** **(Harv.) N.E. Br.**

G. schinzianus Schltr. = ***Pachycarpus schinzianus*** **(Schltr.) N.E. Br.**

G. schizoglossoides Schltr. = ***Aidomene aurea*** **(Schltr.) Nicholas & Goyder**

G. schlechteri K. Schum. = ***Paulforstera schlechteri*** **(K. Schum.) Nicholas**

G. simplex Schltr. = ***Aidomene revoluta*** **(E. Mey.) Nicholas & Goyder**

G. stenoglossus Schltr. = ***Woodia capense*** **(Schltr.) Nicholas**

G. stockenstromense (Scott Elliot) Schltr. = ***Xysmalobium stockensromense*** **Scott Elliot**

G. suaveolens Schltr. = ***Trichocodon suaveolens*** **(Schltr.) Nicholas**

G. suaveolens Schltr. = ***Trichocodon suaveolens*** **(Schltr.) Nicholas**

G. tenuiflora Schltr. = ***Trichocodon campanulatus*** **(Harv.) Nicholas var.** ***sutherlandii*** **(N.E. Br.) Nicholas**

G. tenuis Dietr. = ***Schizoglossum linifolius*** **Schltr.**

G. transvaalensis Schltr. = ***Pachycarpus concolor*** **E. Mey. subsp.** ***transvaalensis*** **(Schltr.) Nicholas**

G. trifurcatus Schltr. = ***Woodia mucronata*** **(Thunb.) N.E. Br. var.** ***trifurcatus*** **(Schltr.) N.E. Br.**

G. truncatus (E. Mey.) Dietr. = ***Paulforstera truncata*** **(E. Mey.) Nicholas**

G. tysonianus (Schltr) Schltr.. = ***Pachyacris tysoniana*** **(Schltr.) Stewart & Langley ex Nicholas & Goyder**

G. undulatus Turcz. = ***Woodia mucronata*** **(Thunb.) N.E. Br. var.** ***mucronata***

G. undulatus (L.) Schltr. = ***Xysmalobium undulatum*** **(L.) Ait.f. var.** ***undulatum***

G. validus Schltr. = ***Pachycarpus asperifolius*** **Meisn.**

G. velutinus Schltr. = ***Aidomene velutina*** **(Schltr.) Nicholas & Goyder**

G. virgatus E. Mey.= ***Aspidoglossum virgatum*** **(E. Mey.) Kupicha**

G. viridiflorum (E. Mey.) Decne. = ***Sigridia viridiflora*** **(E. Mey.) Nicholas var.** ***viridiflora***

G. woodii Schltr. = ***Pachyacris woodii*** **(Schltr.) Nicholas & Goyder**

PAULFORSTERA Nicholas, *gen. nov. Gomphocapri affinis.* ***Herbae*** *perennes.* ***Radix*** *caudex unicus, gracilis, lignosus.* ***Caulis*** *unicus, rarissime ramosibus, 200—840mm elatus.* ***Folia*** *patente, lineare vel lanceolate, marginibus laete revolutis, nervetura inconspicua praeter costaum et aliquando pauces nervos laterales.* ***Inflorescentia*** *nutans vel semipendens, terminalis atque extra-axillaris; bracteis fugaceibus.* ***Flores*** (3-)4—10(–14) *in inflorescentia, rosei, eburnei, albi cineras centes vel lacte brunnescentea.* ***Coronae-lobi*** *saccati, cum vel absque proximalis et/vel distalis appendicibus.* ***Gynoecium****: apex applanatus.* **TYPUS:** *Paulforstera patens* (N.E. Br.) Nicholas.

Description: *Habit*: Perennial herb; with milky latex. *Underground-organ* a single, thin 3—9mm wide, cylindrical, fleshy, deep–seated stem-tuber. *Stems*: One (solitary), unbranched, rarely sparingly 2—3 branched above the base, 200—840mm tall, terete

basally, flattened above, glabrous at base, scabridulous to pubescent apically & at the nodes, rarely bifariously hairy. *Leaves* opposite simple entire spreading, usually paten; lamina narrow-linear, linear to lanceolate, occasionally falcate especially upper leaves, 26—145(-215)mm long, 0.8—4.0(-15.0)mm wide, apex acute to pungent, base minutely auriculate, minutely hastate, margins slightly revolute, venation not pronounced except for the midrib & occasionally a few lateral 2° veins, glabrate, scabrous, puberulous to pubescent; petiole sessile or up to 2.3mm. *Inflorescences* umbel-like, nutans to semi-pendulous, terminal & lateral at the nodes, 1—11 per plant, (3-)4—10(–14)-flowered; bracts, usually linear or triangular, rarely lanceolate, 1.5—5(-7)mm long, 0.1—0.6mm wide, scabrous, pubescent, tomentose to velutinous, fugaceous before anthesis or soon caducous; peduncles (3-)7—20(-40)mm long, scabrous, pubescent to tomentose, unifarious. *Flowers* rotate, 6—17mm wide, 4.5—14.0(-22.0)mm long, pink, cream, white, pale gray or brownish white; pedicels 7—22mm long, tomentose. *Calyx* 5-merous, spreading to reflexed; sepals triangular, lanceolate to ovate, 2.2—5.0mm long, (0.7-)1.0—2.0mm wide, apex pungent to acute, adaxial surface glabrous, abaxial surface scabrous, puberulous to pubescent, green to greeny brown with apex purple. *Corolla* 5-merous, spreading with tips erect, or spreading erect to reflexed, more or less divided to base; petals ovate to elliptic, sometimes papery, (4.0-)5.0—11.5mm long, 3.0—6.5mm wide, apex acute, abaxial surface glabrous, rarely pilose or setose. *Staminal-corona* 1-seriate, 5 merous; lobes of 2 types either simple, undivided into sublobes & arising 0.5—1.5mm above the gynostegial-column base or complicate, sudivided into sublobes & arising at the gynostegial-column base, undivided lobes saccate, 1.3—9.5mm tall, 1.8—4.5mm wide, proximal upper ends blunt & greatly overtopping the style-apex by 0.5—0.8mm, or produced into dentate, subfalcate appendages 1.2—4mm long 0.4—0.8mm wide that project up to or onto the style-apex or erect filiform 7.7—9.5mm long & greatly overtopping the style-apex, upper margin truncate, obliquely sloping down or triangularly indented, distal upper end angular & greatly overtopping the style-apex, blunt sometimes with a cleft-like slit, slightly hooded & lower than the style-apex, or produced into a long filiform 3—6mm long appendage greatly overtopping the style-apex by 1—5mm, outer margin straight or rounded, sometimes with basal ridge-like guide-rails on the sides or wing-like guide-rails on the sides of the inner margins, sinus an appendage free sac-like

cavity 2.5—4.8mm deep, white, cream with pink keel & tips, red-brown, greenish-white, purple-red with white appendages; divided lobes in 3 parts fused at the base into a short tube, free part of 2 laterally compressed subrectangular sublobes 4.4—5.8mm long, 2—3.3mm wide with wing-like guide-rails on the outer upper surface, not reaching the style-apex but reaching to the middle of the anther-wings, distal sublobe short dorso-ventrally compressed dolphin-tail-like (1.6-)2.5—4.0mm long, purple to lilac. *Staminal-column:* 1.8—4.0(-6.0)mm tall; anther-wings curvirostratus (concave in upper half, convex in lower half), hemitriangular to triangular, 0.75—2.0mm long, 0.3—0.9mm, lower margin hooked downwards; anther-appendages ovate, elliptic, oblong (strap-like), spathulate to lingulate, 0.5—2.5(-4.0)mm long, 0.5—2.2mm wide, apex acute, obtuse, rounded, sometimes emarginate, usually white, rarely red-brown, & usually decumbent on the style-apex, rarely erect & exceeding the style-apex by 2.5mm. *Pollinaria*: Pollinia solitary & pendulous in each anther-sac, obclavate, hemipyriform, clavate to obpyriform, longer than broad (except *P. expansa*); translator-arms attached apically to the pollinia; narrowly elliptic, sometimes winged. *Style-apex* truncate with a central pit, rarely obconical, 1.4—3.5(-5.0)mm in diameter. *Follicles*: One by abortion, fusiform, 46—65mm long, ±10mm wide, apex beaked, sometimes acuminate & pungent, surface smooth; pedicels recurbed in fruit. *Etymology*: The genus is named in honour of Paul Forster an Australian asclepiadologist who has contributed extensively to an understanding of the family globally, including contributions to the taxonomy and nomenclature of South African members.

Discussion: This genus consists of three sections containing five species. Corona-lobe, anther and pollinium shape (especially of section *Paulforstera*) all suggest an affinity of this group with the genus *Gomphocarpus*. However, unlike *Gomphocarpus* plants are single stemmed herbs rather than fruticose, stems are solid rather than hollow, and the rootstock is a deep-seated (one meter or more) narrow cylindrical fleshy stem-tuber rather than fibrous. *Paulforstera* is restricted to the coastal zone and adjoining mountain ranges along the eastern sea board of South Africa. This area receives predominantly summer rainfall. As far as possible, we have attempted, for this genus, to list representative specimens not cited in Nicholas 1981 and 1987; much of this cited material has only recently been collected.

Distribution: South African endemic. Eastern coastal zone from Port Elizabeth [Eastern Cape province] in the south to St. Lucia [KwaZulu-Natal province] in the north.

Key To The Subgenera:

1a. Corona-lobes not split into 2 flap-like halves, distal appendage not short & dolphin-tail-like, sinus a central sac-like cavity ..... subgenus *Paulforstera*

1b. Corona-lobes split vertically into 2 flap-like halves, distal appendage short & dolphin-tail-like, sinus a slit & not a sac-like cavity ..... subgenus *Uroglossa*

PAULFORSTERA* Subgenus *PAULFORSTERA

Description: *Underground-organ* 3—8mm wide. *Stems*: 200—780mm tall. *Leaves*: Lamina 26—145(-215)mm long, 0.8—4(-15)mm wide; petiole sessile or up to 2.3mm. *Inflorescences* 1—11 per plant, 4—10(–14)-flowered; 1.5—5.0(-7.0)mm long, 0.1—0.6mm wide; peduncles (3-)7—20mm long. *Flowers* 6—15mm wide, 4.5—14.0(-22.0)mm long; pedicels 7—22mm long. *Sepals* 2.2—5.0mm long, (0.7-)1.0—2.0mm wide. *Petals* ovate to elliptic, sometimes papery, (4.0-)5.0—10.5mm long, 3.0—6.5mm wide. *Corona-lobes:* lobes simple, undivided into sublobes & arising 0.5—1.5mm above the gynostegial-column base or complicate, sudivided into sublobes & arising at the gynostegial base, undivided lobes saccate, 1.3—9.5mm tall, 1.8—4.5mm wide, proximal upper ends blunt & greatly overtopping the style-apex by 0.5—0.8mm, or produced into dentate subfalcate appendages 1.2—4.0mm long 0.4—0.8mm wide & which project up to or onto the style-apex or erect filiform 7.7—9.5mm long & greatly overtopping the style-apex, upper margin truncate, obliquely sloping down or triangularly indented, distal upper end angular & greatly overtopping the style-apex, blunt, or sometimes with a cleft-like slit, slightly hooded & lower than the style-apex, or produced into a long filiform 3—6mm long appendage greatly overtopping the style-apex by 1—5mm, outer margin straight or rounded, sometimes with basal ridge-like guide-rails on the sides or wing-like guide-rails on the sides of the inner margins, sinus an appendage free sac-like cavity 2.5—4.8mm deep, white, cream with pink keel & tips, red-brown, greenish-white or purple-red with white appendages. *Staminal-column* 1.8—4.0mm tall; anther-wings

curvirostratus (concave in upper half, convex in lower half) to hemitriangular, 0.75—2.0mm long, 0.3—0.9mm wide; anther-appendages ovate, elliptic, oblong (strap-like), spathulate to lingulate, 0.5—2.5(-4.0) mm long, 0.5—2.2mm wide, apex acute, obtuse, rounded, usually white, rarely red-brown, usually decumbent on the style-apex, rarely erect & exceeding the style-apex by 2.5mm. *Pollinaria*: Pollinia obclavate, hemipyriform to clavate, longer than broad (except *P. expansa*); translator-arms narrowly elliptic. *Style-apex* truncate with a central pit, rarely obconical, 1.4—3.5mm in diameter. *Follicles*: One by abortion, fusiform, 46—65mm long, ±10mm wide.

Discussion: This subgenus is characterised by its simple corona-lobes that are undivided into sublobes, although they may possess proximal and/or distal appendages of various sorts.

Distribution: As for the genus.

Key To The Sections

1a. Corona-lobes without long erect distal or proximal appendages ..... section *Paulforstera*

1b. Corona-lobes with long erect distal and/or proximal appendages ..... section *Peripodium*

PAULFORSTERA* Nicholas Section *PAULFORSTERA

Description: *Stems:* 200—840mm tall. *Leaves* 30—145mm long, 1—3mm wide; petiole sessile or up to 2.0mm. *Inflorescences* 1—11 per plant, 4—10(–14)-flowered; bracts linear to lanceolate; 1.5—5.0(-7.0)mm long, 0.1—0.5mm wide; peduncles (3-)7—24mm long. *Flowers* 6—15mm wide, 4.5—10.0mm long; pedicels 7—20mm long, white, lilac, cream or pale gray. *Sepals* lanceolate to ovate, 2.2—4.3mm long, 0.7—2mm wide. *Petals* ovate to narrow-elliptic, 4—7.7mm long, 3—5mm wide. *Staminal-corona* arising 0.5—0.8mm above the gynostegial-column base; lobes saccate, 1.3—3.8mm tall, 1.8—4.5mm wide, proximal upper ends blunt & greatly overtopping the style-apex by 0.5—0.8mm, or produced into dentate subfalcate appendages 1.2—4mm long 0.4—0.8mm wide that

project up to, or onto the style-apex, upper margin truncate or obliquely sloping down, distal upper end angular & greatly overtopping the style-apex or blunt sometimes with a cleft-like slit, slightly hooded & lower than the style-apex, outer margin straight or rounded, sometimes with basal ridge-like guide-rails on the sides, or wing-like guide-rails on the sides of the inner margins, sinus an appendage free sac-like cavity. *Staminal-column* 2—4mm tall; anther-wings curvirostratus to hemitriangular, 0.6—2.0mm long, 0.3—0.9mm; anther-appendages ovate, elliptic, oblong (strap-like), 0.5—2.5mm long, 0.5—1.6mm wide, apex acute, obtuse, rounded, white, decumbent on the style-apex. *Pollinaria:* Pollinia obclavate, hemipyriform, longer than broad (except *P. expansa*). *Style-apex* truncate with a central pit, rarely obconical, 1.4—3.2mm in diameter. *Follicles:* ±65mm long, ±10mm wide.

Discussion: This section, consisting of three species, is characterised by its saccate corona-lobes that are free from long appendages (Nicholas, 1987). Amongst other things, the wide variety of different habitats that these closely related species are found in is of interest: *P. gordon-grayae* inhabits bogs, *P. patens* grows in grassy valleys and on grassy forest margins, and *P. trancata* is found in areas of either Natal formation sandstone or Mtsikaba Sandstone.

Distribution: As for the genus.

Key to species:

1a. Anther-appendages short, 0.5 to1.4mm long, 0.5 to 1mm wide 2

1b. Anther-appendages long, 1.7 to 2.5mm long, 1.0 to 1.6mm wide ..... *P. truncata*

2a. Upper corona-lobe edge entire. Plants found in southern Natal & northeastern Eastern Cape province (what was previously Transkei) ..... *P. patens*

2b. Upper corona-lobe edge with a slight cleft near the distal end. Plants found in Zululand ..... *P. gordon-grayae*

1. ***Paulforstera truncata*** (E. Mey.) Nicholas. *Comb. nov.* **Type:** *Drege 4971,* South Africa, Eastern Cape province, between Kei and Umtata Rivers [Holo. † Iso. P] (fig. 12).

Lagarinthus truncatus E. Mey., Comm. Pl. Afr. Austr. 206 [1838]. **Type:** As above.

Gomphocarpus truncatus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias praemorsa Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 8 [1896]. **Type:** As above.

Discussion: This species is similar to the other two in this section in vegetative facie, but differs from them in having the corona-lobes oblong-saccate and greatly overtopping the style-apex (by 0.5 to 0.8mm) and large (1.7 to 2.5mm long, 1.0 to 1.6mm wide) strap-like anther-appendages that are decumbent and connivent over the style-apex. It also differs in its narrower leaves (1.0 to 3.0mm wide), shorter and smaller anther-wings (0.6 to 1.1mm long, 0.3 to 0.6mm wide) and shorter pollinia (0.56 to 0.68mm long). Unlike *P. patens* and *P. gordon-grayae*, this species occurs mainly (but not exclusively) on Mtsikaba sandstone, a rock formation of limited occurence which is found scattered along the coast between Port St Johns and Port Shepstone. This species grows in grasslands amongst rocks often on Mitsikaba Sand Stone (fig. 11), flowers from September to February and occurs at altitudes of between 60 and 450 meters. The specific epithet *trancata* (and *praemorsa*) refers to the truncated upper margin of the corona-lobes which is irregular as if bitten off (fig. 9). We have placed this species first in our series because, of all the species in this genus, it seems to have retained more *Gomphocarpus*-like characteristics; a sister genus from which it may have arisen. Illustrated in Nicholas, 1981 and 1987 (this latter a flower only).

Distribution: South African endemic [Eastern Cape & KwaZulu-Natal provinces only]. (Fig. 10).

Conservation Status: Low Risk (Near Threatened) following Scott-Shaw (1999). Populations recorded around the Durban area some 100 years ago (and which formed the northern most portion of the species range) are in all probability now extinct.

Representative Specimens: South Africa: KwaZulu-Natal: *Wood s.n.*, Near Pinetown [GRA]; *Wood 1162*, Krantzkloof [NH]; *Williams 170*, Winston Park [NH]; *Abbott 1415*, Umtamvuna Nature Reserve [NH]; *Glen 520*, Oribi Gorge [J]; *van Wyk 5123*, Oribi Gorge [PRE]; *Strey 7772*, Beacon Hill [NH, PRE]; Manning 279, Port Edward [NU];

Figure 9. *Paulforstera gordon-grayae:* a. Whole plant showing habit & habitat (0.8 meters tall), inset close up of flowers; b. & c. Close up of flowers showing color variation. *P. truncata:* d. Whole plant showing habit (0.5 meters tall); e. Close up of flowers; f. flowering stem. Photographs: a, d & e by A. Nicholas; b by S. Stewart; c by W. Menne and; f by R. Williams.

Strey 6216, Excelsior farm [NH]; *Acocks 13351*, Near Port Edward [PRE]. Eastern Cape: *Nicholas 2388 with Smook*, Mkambati Nature Reserve [PRE]; *A & G Hutchings 1766 with Plumstead*, Mkambati [KEI]; *Hutchings 738*, Lupatana [KEI]; *Jordaan 1043*, Mkambati Nature Reserve [NH]; *Bowker s.n.*, Kreilis country [TCD]; *Bayliss 2542*, Lusikisike. 2542 [NBG]; *Tyson 2630*, between unKwani & Umsakaba [BOL, SAM]; *van Hoepen 1992*, Mkambati [PRE]; *Shackleton 388*, Mkambati [PRE]; *Balkwill & Manning 388*, Umtamvuna nature Reserve [NU].

2. ***Paulforstera patens*** (N.E. Br.) Nicholas. *Comb. nov.* **Type:** *Pegler 366*, South Africa, Eastern Cape province, Kentani [Lecto. K. Isolecto. BOL, PRE, SAM]. Chosen here. *Bowker 37*, Kreilis country [Isosyn. TCD]; *Galpin 3446*, near Port St. John [Isosyn. PRE].

Asclepias patens N.E. Br., in Thiselton-Dyer, Fl. Cap. 4(1): 674 [1908]. **Types:** As above.

Discussion: Unlike *P. trancata* the corona-lobes do not overtop the style-apex, they are also wider than high, and the anther-appendages are broadly ovate. *P. patens* is found growing on grassy slopes of valleys, often amongst tall unburned grass on forest margins. It flowers between September and February, peaking in December, and occurs at altitudes of 150 to 360 meters. The specific epithet referes to the leaves which spread at 90° degrees to the stem; a character actually expressed by all species in this genus. On Galpin 3446 [PRE] Schlechter has written *Asclepias pondoica* Schltr. *sp. nov.*, but this name was never validly published. Illustrated in Nicholas, 1981 and 1987 (this latter a flower only).

Distribution: South African endemic [Eastern Cape province only]. (fig. 10).

Conservation Status: Vulnerable. Following Scott-Shaw (1999). It is a rarely collected species of restricted distribution being found along the coast between Kentani and Port St. Johns. Although categorized as vulnerable this species is on its way to being considered endangered.

Representative Specimens: South Africa: Eastern Cape: *Dold 1928 with Cocks*, Beechamwood, Gatyana Coast Reserve [GRA, UDW]; *Dold 1216*, Nqundulawane river mouth [GRA]; *Dold 608 & 609*, near Nqabe river mouth [GRA]; *Moss 4706*, Port St.

Johns [J]; *Swinny & Barker 14131*, Port St. Johns [PRE]; *Gordon-Gray 961*, The Haven [NU]; *Pegler s.n.*, Kentani [SAM 4972]; *Blenkiran s.n.*, Ntenbane [J 16155]; *Mogg s.n.*, Port St. Johns [PRE 51764]; *Schonland 4172*, Port St. Johns [GRA]; *Bowker s.n.*, Kreilis country [TCD].

3. ***Paulforstera gordon-grayae*** (Nicholas) Nicholas. *Comb. nov.* **Type:** *Nicholas 1258,* South Africa, Natal, Zululand, St. Lucia, Eastern Shores State Forest, Simbonvini vlei [Holo. PRE; Iso. CPF, K, NH, MO].

Asclepias gordon-grayae Nicholas, Bothalia 17(1): 17 [1987]. **Type:** As above.

Discussion: This species is very similar to *P. patens*, but differs from this species in its flower color (white to pink versus white tinted brown or lilac), corona-lobe size and shape (1.3 to 2.6mm tall, 2.3 to 3.3mm wide versus 2.4 to 3.4mm tall, 3.0 to 4.4mm wide), anther-appendage size and shape (ovate to elliptic and 1.0 to 1.4mm long, 0.5 to 1.0mm wide versus broadly ovate and 0.5 to 1.0mm long, 0.6 to 1.0mm wide), and pollinia width (0.4 to 0.52mm versus 0.32 to 0.4mm wide) (fig. 9). There is also a difference in habitat, with *P. gordon-grayae* being found in marshy situations in black peaty soil amongst tall unburned grass and *P. patens* on grassy hillside slopes. The distribution is also different *P. gordon-grayae* being found in coastal Zululand and *P. patens* in coastal Transkei. Illustration and distribution in Nicholas 1981 and 1987.

Distribution: South African endemic [KwaZulu-Natal province only]. (fig. 10).

Conservation Status: Vulnerable. Following Scott-Shaw (1999). Many of Zululand's coastal wetlands are threatened by farming, aforestation and open pit mining for titanium.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1074*, Nogye [NH, NU, PRE]; *Venter 2437*, Ngoye Forest Reserve [BLFU]; *Williams 1019*, Ngoya Forest Reserve [NH]; *Stirton 466*, Ngoye [K, PRE]; *Strey 6106*, Ngoya [K, NH, NU, PRE]; *Lowrey & van Wyk 1058*, Ngoya [NH]; *Gordon-Gray 6191*, Ngoya [NU]; *Schrire 2135*, Ngoye Forest [NH]; *Wood 10823*, Ngoya [BOL, PRE, SAM]; *Gordon 407*, Dukuduku State Forest [NH, PRE]; *Williams 848*, KwaMbonambi [NH]; *Pooley 1819*, St. Lucia

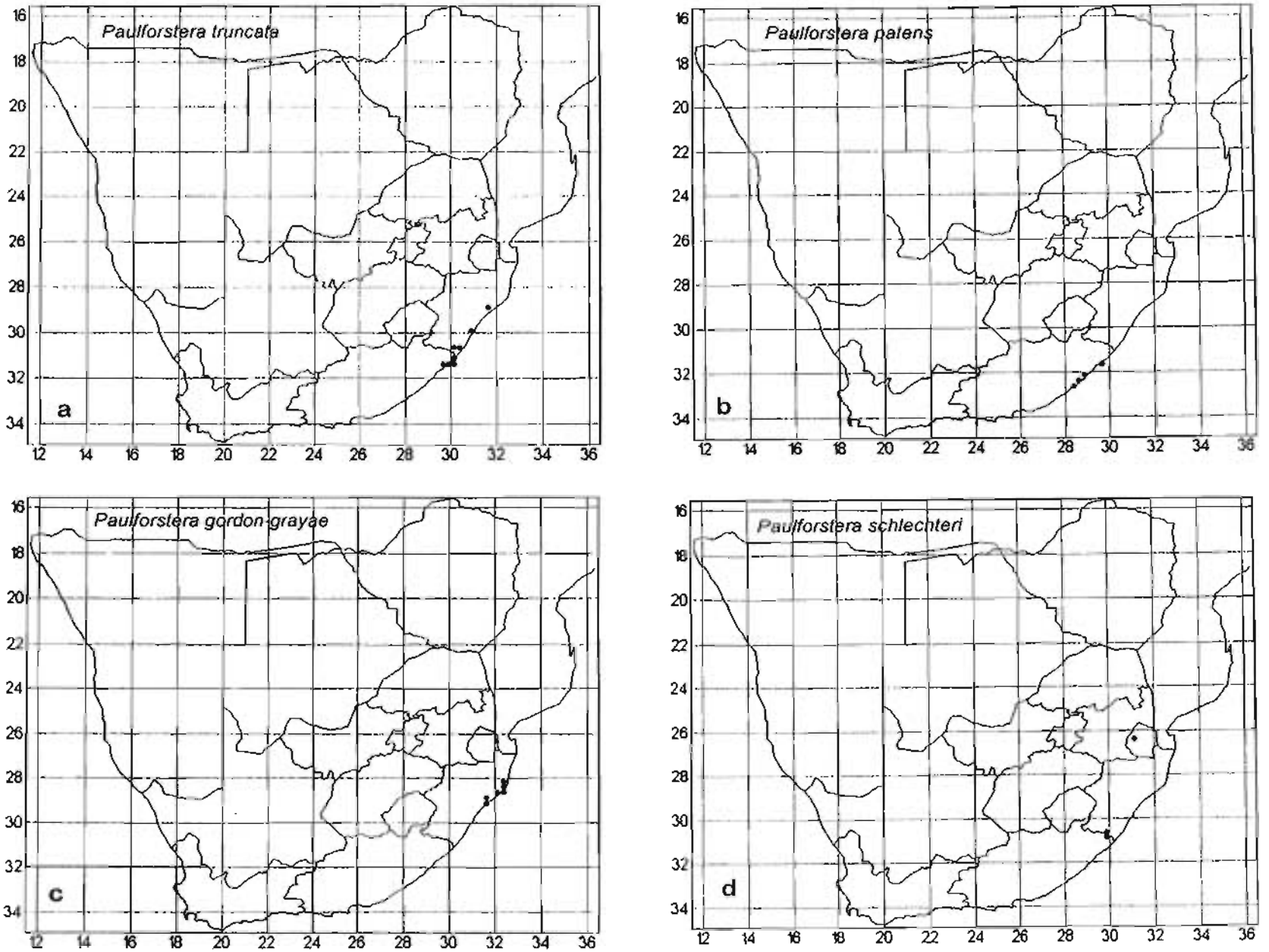


Figure 10. Distribution maps of: a. *Paulforstera truncata*; b. *P. patens*; c. *P. gordon-grayae* and; d. *P. schlechteri*.

[NU]; *Wood 10828*, Ginginhlovu [PRE, SAM]; *Ward & Begg 11724*, Lake Nhlabane [UDW], *Williams 848*, KwaMbonambi, Langepan [PRE].

PAULFORSTERA **Nicholas Section *PERIPODIUM*** Nicholas *sectio nov.* ***Caulis*** *unicus non filiformis, 220—720mm longus.* ***Flores*** *7—15mm longi, 9—22mm lati, brunnescente albidi vel cremeus.* ***Corolla*** *(6–)7.5—11.2mm longa, (3.4–)4—6.5mm lata.* ***Coronae lobe*** *mitriforme cum proximalibus lobiorum extremitatibus atque distalibus prolongate, appendicibus proximalibus aut longis et pinniformibus (P. expansus) aut brevibus et dentatis (P. schlechteri), appendicibus distalibus longis et filiformibus, si longis nune appendicibus proximalibus inflexis, distalibus reflexis.* ***Antherae appendice*** *aut longae, erectae et spathulatae aut breves procumbentesque.* **TYPUS:** *Paulforstera expansa* (E. Mey.) Nicholas, *vide infra*.

Description: *Underground-organ* 3—8mm wide stem-tuber. *Stems*: Not wiry, 220—720mm long. *Leaves*: Blades linear to narrow-lanceolate, occasionally falcate, (26-) 42—120(-215)mm long, 0.8—3.5mm wide; petiole 0—1.5mm long. *Inflorescences* 2—9 per plant, 4—8(–10)-flowered; bracts lanceolate; 2.4—6.2mm long, 0.3—0.6mm wide; peduncles 4—27mm long. *Flowers* 7—15mm wide, 9—22mm high, brownish white, creamy brown to cream; pedicels 7—22mm long. *Sepals* lanceolate to narrow-ovate, 2.5—5.0mm long, 1.0—1.8mm wide. *Petals* narrow-ovate, ovate, narrow-elliptic to elliptic, sometimes papery, (6.0–)7.5—11.2mm long, (3.4–)4.0—6.5mm wide. *Staminal-corona* arising 1—1.5mm above the gynostegial-column base; lobes simple, undivided into sublobes, complicate-saccate (like an upturned Bishops mitre), 5.8—9.5mm tall, 1.8—4.0mm wide, produced into short dentate subfalcate erect appendages 0.9—1.2mm long, exceeding the style-apex by 1.0—1.8mm (*P. schlechteri*), or erect filiform fin-like appendages (1.7-)2.0—3.5(-4)mm long with a gibbosity at about the level of the style-apex the rest extended up, over & exceeding the style-apex by 5mm (*P. expansa*), upper margin triangularly indented, distal upper end produced into a long filiform 3—6mm long pungent appendage greatly overtopping the style-apex by 1—5mm & reflexed away from the flower center, outer margin straight or slightly rounded, sometimes with basal ridge-like guide-rails on the sides, sinus 2.5—4.8mm, white, greenish-white or purple-red with

white appendages. *Staminal-column:* 1.8—3mm tall; anther-wings curvirostratus to hemitriangular, 0.75—1.4mm long, 0.4—0.7mm wide; anther-appendages spathulate to lingulate, 0.8—4.0mm long, 0.6—2.2mm wide, decumbent on the style-apex (*P. schlechteri*) or erect, exceeding the style-apex by 2.5mm & mixing with the corona-lobe appendages (*P. expansa*). *Pollinaria:* Pollinia clavate, hemipyriform to hemiovoid. *Style-apex* truncate with undulating margins, 2.0—3.5mm in diameter. *Follicles:* 46mm long, ±9mm wide, apex beaked & pungent. *Etymology*: Named from the Greek prefix *peri-* (= surrounding) and suffix *-podium* (= foot). In reference to the many erect corona-lobe appendages and anther-appendages that surround the gynostegial-column.

Discussion: This section, which consists of two species, differs from the type section in that the corona-lobes have a long filiform distal appendage and in *P. expansa* a long filiform proximal appendage.

Distribution: As for the genus.

Key to species:

1a. Anther-appendages erect & spoon-shaped; corona-lobes with long filiformis, falcate proximal appendages ..... *P. expansa*

1b. Anther-appendages not erect or spoon-shaped; corona with short, dentate, proximal appendages ..... *P. schlechteri*

4. ***Paulforstera schlechteri*** (K. Schum.) Nicholas *comb. nov.* **Type:** *Huntley 769,* South Africa, Eastern Cape Province, Bizana [Neotype NU]. Chosen here. *Bachman 1083,* South Africa, Eastern Cape province, Transkei, between Roskowe & Canham [Holo. B† *n.v.*]. Type not traced; probably destroyed when the Berlin herbarium was bombed during the second world war?

Gomphocarpus schlechteri K. Schum., in Engl., Bot. Jahrb. 33: 325 [1904]. **Types:** As above.

Asclepias schlechteri (K. Schum.) N.E. Br., in Thiselton-Dyer, Fl. Cap. 4(1): 714 [1908]. **Types:** As above.

Discussion: According to Gunn & Codd (1981), Bachmann's specimens are mainly housed at Kew and Berlin herbarium, however, we have been unable to locate the type of this species (*Bachmann 1083*) at either. As a result, we have decided to neotypify this species and so fix its position and prevent confusion. The specimen cited here (*Huntley 769* housed at NU) fits Schumann's (1904) description of *Asclepias schlechteri* exactly. N.E. Brown (1908), who had not seen the Bachman specimen either (or any of the specimens cited here), suggested that it may prove to be the same as *P. expansa* but although it is similar it is also quite distinct. Other differences are outlined in table 3. *P. schlechteri* appears first in our series, because in its less ornate floral structure it is more similar to section *Paulforstera* than *P. expansa*. Interestingly, the vegetative facie and corona-lobe shape of this species is very similar to some species of *Stathmostelma*, but this is probably due to convergent evolution. In all other features, including pollinaria, this species is quite different to *Stathmostelma*. This species is of retricted and quite disjunct distribution. Original only known from a very small area in KwaZulu-Natal around Harding, recently two specimens of this species were encountered that had been collected in Swazililand. This is just such an odd ditribution, involving two quite different types of habitat, that we believe the Swaziland specimens might have had the wrong label information attached (fig. 10). It flowers between October to January, and is found at altitudes of about 800 meters. This species was named in honour of Rudolf Schlechter one of the mot prolific workers in the family Asclepiadaceae (see Nicholas, 1992). Illustrated in Nicholas 1981.

Table 3: Listing the differences between *P. schlechteri* and *P. expansa*.

Character	***P. schlechteri***	***P. expansa***
Stem height	530—550mm	220—720mm
Leaf length	45—95mm	26—215
Petiole length	0.0—0.5mm	0.0—1.5mm
Flower height	9—14mm	9—22mm
*Pedicel length	7—12mm	13—22mm
Sepal shape	Lanceolate	Narrow-ovate
Sepal length	3.5—4.5mm	2.5—5.0mm
Corona-lobe length	7.7—9.4mm	5.8—9.5mm
*Corona-lobe width	±3.4mm	1.8—3.2mm

Proximal corona-lobe appendage shape	Short & dentate exceeding style-apex by 1.0—1.8mm	Long & fin-like exceeding style-apex by 5.0mm
Proximal corona-lobe length	0.9—1.2mm	1.7—4.1mm
Distal corona-lobe length	4.8—6.0mm	3.0—5.5mm
*Staminal-column height	±1.8mm	2.0—3.0mm
*Anther-wing length	1.1—1.4mm	0.75—1.1mm
Anther-wing width	0.5—0.7mm	0.4—0.6mm
Anther-appendage shape	Lingulate	Spathulate
*Anther-appendage length	0.8—0.9mm	2.4—4.1mm
*Anther-appendage color	White	Red-brown
Pollinium length	0.88—1.0mm	0.56—0.80mm
Pollinium width	0.32—0.4mm	0.4—0.6mm

* Characters exhibiting non-overlapping ranges or shapes.

Distribution: Southern African endemic. South Africa [KwaZulu-Natal province only] and Swaziland. See discussion above.

Conservation Status: Endangered. Following Scott-Shaw (1999). *P. schlechteri* is rare having only been collected about seven times, and in KwaZulu-Natal grows in a region of high population and extensive agriculture, aforestation and dairy farming.

Representative Specimens: South Africa: KwaZulu-Natal: *Lenox s.n.*, Bedford farm, Harding [NU 32 814]; *Thode 2579*, Kenterton [STE]; *Balkwill & Cadman 2786,* Bedford farm, Harding [J]. **Swaziland:** *Hilliard 3105*, The caves, Mbabane [PRE]; *Hilliard s.n.*, Komati pass [PRE 31215].

5. *Paulforstera expansa* (E. Mey.) Nicholas *comb. nov.* **Type:** *Drége 4972,* South Africa, Cape province , near Kachu. [Holo. B† Iso. K].

Lagarinthus expansus E. Mey., Comm. Pl. Afr. Austr.: 206 [1838]. **Type:** As above.

Gomphocarpus expansus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias expansa (E. Mey.) Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 7 [1896]. **Type:** As above.

Discussion: The flowers of this species are unique and quite extrodinary. This is due to its complex corona-lobes that possess long proximal and distal appendages. The anther-appendages are spathulate, erect and reddy brown in color. In fact, N.E. Brown (1908) remarked that "the petaloid anther-appendages of this species are very remarkable." Together the corona-lobe appendages and anther-appendages stick up and out from the flower giving it an almost spike-like apperance (fig. 11). The pollinia are also broader than those of section *Paulforstera*. As long ago as 1896, Schlechter pointed out the affinity of this species to *P. peltigera* and *P. truncata*. Plants flower from October to January, peaking November to December and occur at altitudes of between 150 to 300 meters, rarely as high as 900 meters. It occurs in mountain grasslands, occasionally near forest margins. Illustrated in Nicholas 1981.

Distribution: South African endemic [Eastern Cape province only]. (fig. 12).

Conservation Status: Low Risk (Near Threatened). A number of collectors report this species to be rare, certainly it is seldom collected these days. Its long term survival is unlikely and it should be considered vunerable to endangered.

Representative Specimens: South Africa: Eastern Cape: *Nicholas 2707 with Barker*, Zurrberg National Park [PRE]; *Zeyher 591*, Van Staaden mountains [BOL, TCD]; *Hutton s.n.*, near Grahamstown [K]; *Bowker 373*, Fort Bowker, Bashee [TCD]; *Flanagan 398*, Komgha [BOL, GRA, NH, PRE, SAM]; *Schlechter 6211*, Impetura [NH]; B & M *van Wyk 1171*, Zuurberg National Park [PRE]; *Bowker s.n.*, Kreilis country [TCD]; *Alexander s.n.*, Uitenhage [TCD]; *Foucarde 6343*, Zuuranys Pass [JF, BOL, STE]; *Dahlstrand 2583*, Van Staadens Flower Reserve [GRA, J]; *Vlok 563*, Tenstop hill, Groendal State Forest [PRE]; *Sims 2415*, Mt. Coke [NU]; *Wood 3380*, East London [PRE, SAM]; *Glass 1504*, Howison's Poort/Cold Spring [SAM]; *Pegler 1481*, Kentani [BOL, GRA, SAM]; *Pegler 216*, Kentani [BOL, PRE, SAM]; *Vlok 919*, Cockscomb Peak [PRE]; *Hutton s.n.*, Howison's Poort, near Grahamstown [TCD]; *Hilliard & Burtt 11071*, Haga Haga [NU].

Figure 11. *Paulforstera expansa:* a. Whole plant showing habit & habitat (0.8 meters tall); b, side view of flowers; c. Top view of flowers; e. Umtamvuna Nature Reserve. This coastal grassland, which occurs on Mtsikaba Sand Stone, is home to many endemic species; as well as many asclepiads, including *P. truncata.* Photographs by A. Nicholas.

PAULFORSTERA *Subgenus* ***UROGLOSSA*** Nicholas *subgen. nov.* ***Caulis*** *unicus, erectus, 310—820mm longus.* ***Flores*** *6—11mm longi, 11—17mm lati, subrosei, lilacini vel lilacini et albi.* ***Corolla*** *reflexa, 7.5—11.4mm longa, 4—6mm lata.* ***Coronae lobi*** *lateraliter visi oblongi, turriformes, 4.4—5.8mm longi, 2.1—3.3mm lati, in binis sublobis lateralibus divisis, et cum appendice brevi distali. Appendi distalis crassa, (1.6–) 2.5—4.0mm longa, apice dilatata et complanata, caudiformis. Coronae sinus rimiformis. Antherae appendices parvae, membranaceus, procumbentes.* **TYPUS:** *Paulforstera peltigera* (E. Mey.) Nicholas, *vide infra.*

Description: *Underground-organ* 6—9mm wide. *Stems*: 310—820mm tall. *Leaves*: lamina usually linear, ocassionally lanceolate or falcate, 50—114mm long, 1—4mm wide, apex sharpely pointed, base usually minutely auriculate, occasionally minutely hastate; petioles sessile or up to 1.5mm. *Inflorescences* 1—6 per plant, (3-)4(–6)-flowered; bracts usually linear-triangular, ocassionally narrow-lanceolate to lanceolate, (2.0-)3.9—5.0mm long, 0.3—0.6mm wide, scabrous to pubescent; peduncles (8-)12—20(-40)mm long, scabrous to pubescent. *Flowers* 11—17mm wide, 6—11mm high, pink, lilac or lilac & white; pedicels 11—20mm long. *Sepals* lanceolate, occasionally ovate, 2.3—4.0mm long, 1—2mm wide, abaxial surface scabrous to pubescent. *Petals* usually ovate to narrow-elliptic, occasionally elliptic, 7.5—11.5mm long, 4—6mm wide, abaxial surface scabrous. *Staminal-corona:* Arising at the gynostegial-column base; lobes sudivided into 3 sublobes fused at the base into a short tube, free part of 2 laterally compressed subrectangular sublobes 4.4—5.8mm long, 2.0—3.3mm wide with wing-like guide-rails on the outer upper surface, not reaching the level of the style-apex but reaching to the middle of the anther-wings & a dorso-ventrally compressed short basal & distal dolphin-tail-like sublobe (1.6-)2.5—4.0mm long, purple to lilac. *Staminal-column:* 5—6mm tall; anther-wings triangular, 1—2mm long, 0.45—0.6mm; anther-appendages transversely oblong or narrowly elliptic, 0.48—1.2mm long, (0.44-) 1.2—1.7mm wide, apex emarginate, decumbent on the style-apex. *Pollinaria*: Pollinia obpyriform. *Style-apex* truncate, 2.3—5.0mm in diameter. *Follicles:* 62mm long, ±10mm wide. *Etymology*: Named from the Greek, *uro* (= tail) and *glossa* (= tongue) in reference to the distal dolphin-tail-shaped appendage on the corona-lobe.

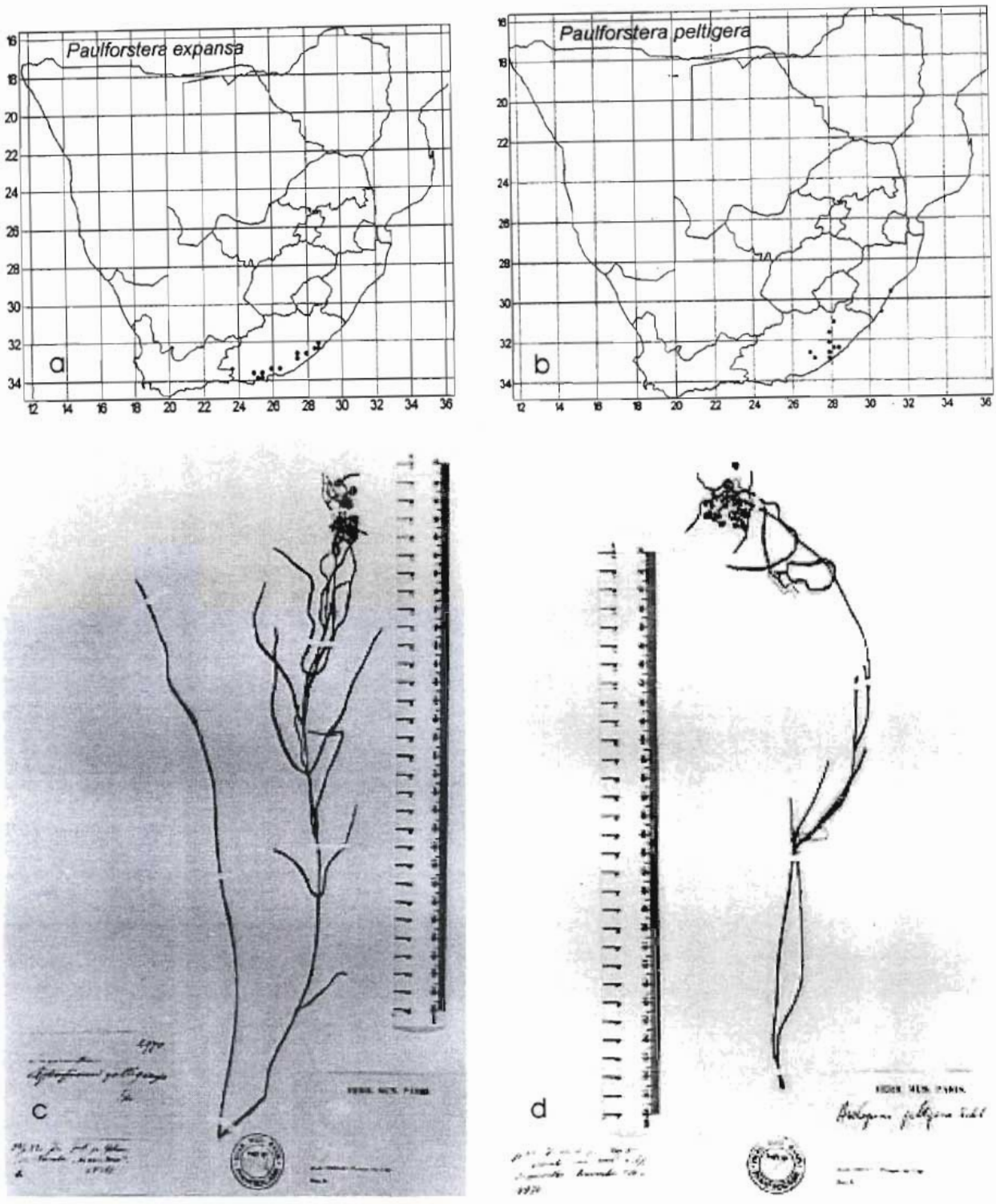


Figure 12. Distribution maps of: a. *Paulforstera expansa*; b. *P. peltigera*. c. Isosyntype of *P. truncata* Drege 4971 (P) and; d. Lectotype of *P. peltigera* Drege 4970 (P).

Discussion: This subgenus consists of one species; *P. petigerus*. Although treated as separate and distinct by Nicholas (1981), vegetatively this species clearly belongs in *Paulforstera*. However, the flower with its tripartite corona-lobe, basal coronal curtain, and large pollinarium are unusual but not enough for it to be placed in its own genus. The resemblance of the corona and polliniarium shape to those in the genus *Calotropis* R. Br. is probably due to convergence and is considered by these authors to be a homoplasious character.

Distribution: South African endemic. Eastern Cape and Kwazulu-Natal provinces only.

6. ***Paulforstera peltigera*** (E. Mey.) Nicholas *comb. nov.* **Type:** *Drége 4970,* South Africa, Eastern Cape province, in grassland between Kei and Bashee. [Lecto. P] (fig. 12). Choosen here. *Drége s.n. (IV, c),* South Africa, Eastern Cape province, Vanstaaden's Mountains, in rocky areas, alt. 1500ft (= 457m) [Syn. *n.v.*]. *Drége s.n. (V, c),* South Africa, Eastern Cape province, between Umkomas and Umlaas, alt. 500fr (= 152m) [Syn. *n.v.*].

Lagarinthus peltigerus E. Mey., Comm. Pl. Afr. Austr.: 205 [1838]. **Types:** As above.

Gomphocarpus peltigerus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Types:** As above.

Asclepias peltigera (E. Mey.) Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 8 [1896]. **Types:** As above.

Asclepias truncata Harv., non Dietr., Thes. Cap. 1: 42 & t67 [1895].

Discussion: The corona-lobes are divided into three sublobes and there is not true coronal sinus, the lobes join to form a distinct, almost fleshy coronal-curtain around the staminal-column, and the pollinia are large (up to 1.2mm long). The corona-lobes are lower than the style-apex (reaching to the middle of the anther-wings) and the anther-wings are triangular. This species is found growing in grassy valleys and on hillside slopes in the coastal zone. Plants flower between October and January, and are found at altitudes from 30 to 100 meters. Illustrated in Harvey (1859), Wood (1912) and Nicholas (1981).

Distribution: As for the subgenus. (fig. 12).

Conservation Status: Vulnerable. Following Scott-Shaw (1999). Five collections have been made in KwaZulu-Natal, but these were collected over a century ago. The lack of recent collections, despite proactive attempts to recollect, tends to indicate that the species may be extinct in this province. A similar phenomenon can be seen in the Eastern Cape province, where many of the older collecting sites are now heavily over grazed by cattle; despite their bitter latex and cardioglucosides many southern African asclepiads are unfortunately palatable to cattle and other animals. *P. peltigera* was frequently collected at the turn of the century but rarely so now.

Representative Specimens: South Africa: KwaZulu-Natal: *Gerrard & McKen 1984*, Port Natal [TCD]; *McMartindale s.n.*, Verulam [NH 12530]; *Wood 879*, Umzumbi [NH]. *Maurice & Evans 732*, Dumisa [NH]; *Sanderson 371*, without precise locality [TCD]. Eastern Cape: *Hutchings 889*, Zibungu [KEI, NU]; *Dold 2893*, Mnyolo [GRA]; *Bowker (Barber) 7*, near Butterworth [GRA, PRE, TCD]; *Schlechter 6171*, Komgha [GRA, NH]; *Flanagan 393*, Komgha [BOL, GRA, PRE, SAM]; *Phillipson 1168*, Menziesberg [PRE, UFH]; *Sim 2416*, Sages' Bush, Pirie [NU]; *Arnold 5835*, Amalinda [GRA, PRE]; *Pegler 365*, Kentani [BOL, PRE, SAM]; *Pegler 366*, Kentani [PRE, SAM]; *Arnold 5835*, Amalinda [GRA, PRE]; *Cooper 470*, without precise locality [TCD].

SIGRIDIA Nicholas *gen. nov, Gomphocarpi subgeneri Leiocalymmi affinis.* ***Herba*** *perenni, omnino hirsuta.* ***Radi*** *caules-tubere unicus, lignosus profundus.* ***Caules*** *1—3, simplices vel ramosi, 75—420mm elati.* ***Folia*** *4 ad 10 in caule, patentic vel adscendentia, 18—110mm longe, 1.5—40mm lata, linearas, lineari-oblonga, lanceolata, ovata vel elliptico-oblonga, basin cuneata, rotundata vel leviter cordata, marginibus planis vel crispatis.* ***Inflorescentiae*** *umbelliformis, terminales vel terminalis et extra-axillares.* ***Flores*** *3—10 in inflorescentia, virides, pedicellis inaequalibus.* ***Corolla*** *patens vel reflexa, apice cum minuto incisura, pagina abaxiale villoso vel tomentoso.* ***Corona lobi*** *compressi, cucullata quadrangularis ad cyathiformes, margine superiore obliquo vel truncato ad declivi, cum extremitate superiore proximale appendicis dentato, falcato vel filiformis, producta, et apicem gynoecii per 2.5mm excedente; sinus fissura brevis vel*

profunda et saccato. ***Antherae appendix*** *ovata vel reniformis et apice fissurata.* ***Gynoecii*** *apex truncatus.* ***Fructus*** *lanceolato-fusiformis, rostratus cum dis r verticalibus serratis.* ***Typus****: Sigridia cultriformis* (E. Mey.) Nicholas, *vide infra.*

Description: *Habit*: Perennial herb; with milky latex. *Underground organ* a deep-seated fleshy to slightly woody cylindrical or turnip-shaped stem-tuber, 5—8mm wide. *Stems* usually 1, occasionally up to 3, usually unbranched, sometimes branched, erect, 75—415mm tall, teretee at base, flattened & channelled above, glabrous, scabrous, puberulent, pubescent, or densely & softly villous with rusty to golden-brown or white hairs, these sometimes concentrated at nodes or unifarious or bifarious, rarely glabrous. *Leaves* 4 to 10 per stem, opposite, simple, entire, spreading (sometimes with apical part curved down) to spreading erect; lamina linear, linear-lanceolate, narrow-lanceolate, linear-oblong, narrowly lanceolate, lanceolate, narrowly oblong-lanceolate, ovate-lanceolate, elliptic, elliptic-oblong, ovate-oblong, elongate-ovate, 18—110mm long, 1.5—40.0mm broad, apex very narrowly acute, acute to obtuse & sometimes mucronate, base tapering, rounded, subcordate to cordate, margins smooth or crispate, flat or revolute, usually only midrib prominent below, rarely 2° veins visible, scabridulous, scabrous, puberulent, pubescent, pilose (long spreading white hairs) to subvillous, sometimes hairs confined to midrib only, hairs rusty or white colored; petioles sessile or up to 7mm long. *Inflorescences* (1-)2—6 per branch, racemosely or subcorymbosely arranged on the stem, umbel-like, flowers all produced at the same level or unequal, produced terminally & lateral, 2—3 from a node rarely terminal & solitary, erect to pendulous, (2-)5—10 flowered; bracts setaceous, filiform, linear, linear-subulate, linear triangular, 2.0—6.8mm long, 0.2—0.5mm wide, puberulent to pubescent; caducous or persistent, peduncles 10—70mm long, either all of the same length or unequal, subglabrous, scabrous, puberulent, pubescent, tomentose or villous. *Flowers* rotate (spreading or reflexed), 8—9mm wide, 6—7mm high, brilliant green, green, green & purple, greenish-brown; pedicels unequal (0.7-)5.0—25.0mm long, hairy. *Calyx* spreading to reflexed; lobes lanceolate, ovate-lanceolate to triangular, 2—9mm long, 1.0—3.4mm wide, apex pointed to acute, adaxial surface pubescent to villous, abaxial surface glabrous, purple tinted green. *Corolla* spreading to reflexed, usually with apex turned upwards, almost divided to base; lobes ovate, ovate-elliptic, narrow-elliptic, elliptic, broadly elliptic to elliptic-oblong, 5.2—

15.0mm long, 2.8—11.5mm, apex acute to subacute & sometimes minutely notched, adaxial surface purple brown, purplish or green & pubescent, densely white haired to thinly pilose, abaxial surface brown or greenish-brown & glabrous; margin lighter & glabrous, woolly & almost tomentose. *Staminal-corona* in 1-series, 5-merous, arising at base or 0.4—1.5mm above the gynostegial-column base; lobes free above, laterally compressed, fleshy (sometimes almost solid) to non fleshy, cucullate, quadrangular, subquadrate to subdeltoid in side view, 1.6—5.0mm high, 1—8mm wide, upper proximal ends extended into short to long dentate or deltoid-falcate teeth that project onto the style-apex (0.7—0.8mm long) or erect, filiform (0.7—2.3mm long, ±0.5mm wide) & greatly overtopping the style-apex, sometimes connivent, occasionally more or less blunt upper distal ends ±blunt, obliquely truncated, rounded, slightly angled or deltoid-obtuse point & level or just below the level of the style-apex, upper margin sloping obliquely down from the proximal to the distal end, truncated, sometimes rimmed, shallowly concave or a v-shaped cleft, outer keel rounded, straight or slightly concave, sometimes with a small triangular ridge of tissue near the base, sides flat or slightly pinched inwards & with basal guide-rails, sinus a shallow furrow (lobes more or less solid) to deep central fissure, usually devoid of a central appendage, or sometimes with a deltoid, acute tongue-like appendage, smooth inside or minutely puberulous, white with a purple or violet spot on the back near the apex, green with keel & basal part dark purple, violate at base. *Staminal-column* 2.2—5.6mm tall; anther-wings with outer margin shallowly concave, basal margin truncate, 0.5—0.8mm long, 0.32—0.5mm wide; anther-appendages broadly ovate, reniform, transversely rhombic, transversely elliptic, transversely rounded to suborbicular, 0.4—0.75mm long, 0.9—1.0mm wide, apex obtuse, rounded, widely cleft or triangularly cleft, white & membranous, decumbent on the style-apex margin or applied to its side. *Pollinarium*: Pollinia solitary & pendulous in each anther-sac, semi ovate (outer margin broadly convex, inner margin straight) to oblong; translator-arms attached apically, twisted or bent down, thin & transparent in the upper 1/3, opaque in the lower 2/3; corpusculum rhomboid to oblong. *Style-apex* truncated with undulate margins slightly thickened above the stigmatic surface & with a central depression, 1.6—2.1mm wide. *Fruit* Usually solitary, erect, lanceolate-fusiform, 75—115mm long, 12—20mm wide, apex beaked, surface with 4 vertical serrated wings, rusty puberulous hairs when

young. *Seeds*: Ovate, dorso-ventrally flattened, 3.2mm long, 2.8—3mm wide, margins incurved, abaxial surface concave & deeply furrowed, adaxial surface concave, surface rugulose. *Etymology*: Named in honour of Asclepiadologists Prof. Dr. Sigrid Liede who has worked extensively on the family Asclepiadaceae contributing to its micro and macro-taxonomy as well as to our knowledge concerning its morphology, pollination and evolution.

Discussion: As was pointed out by Goyder (1997), *S. cultriformis*, *S. rara* and *S. viridiflora* are related and exhibit many common characteristics. To their ranks we here add *S. bicuspis* and *S. concinna*. *S. viridiflora* bears some similarity to *Gomphocarpus* subgenus *Leiocalymma*, but any phylogenetic connection is distant. Similarities between *S. viridiflora* and *Gomphocarpus* subgenus *Leiocalymma* include the following: Semi-woody to fleshy stem-tuber, glaucous tinged leaves with crispate margins, leaves that may have a caudate to rounded base, corolla reflexed, similar shaped corona-lobes and serrated longitudinally winged fruits. However, it also differs in a number of important ways, viz.: in its smaller habit (never more than 400mm tall), solid stems, peduncles that are often of unequal length (so that the flowers are held on the plant in a corymbose fashion) and green, greenish brown or butter-yellow flowers. *S. viridiflora* is placed first in our treatment to indicate its closer connection with *Gomphocarpus*. *S. viridiflora* may seem quite different to *S. cultriformis*, however, the two are connected via *S. rara* which is somewhat intermediate between the two.

Distribution: African endemic. Southern Africa in South Africa [Western Cape, Eastern Cape, KwaZulu-Natal, Free State, Mpumalanga, Gauteng & North-West provinces] and Swaziland. Also in tropical Africa.

Key to Species:

1a Plants pubescent to subglabrous with rusty brown colored hairs;
flowers brilliant green, green, greenish yellow or butter-yellow ..... *S. viridiflora*

1b Plants villous to pilose with white colored hairs;
flowers greeny brown 2

2a Corona-lobes with a concealed tongue-like appendage in the sinus cavity ..... *S. cultriformis*

2b Corona-lobes without a concealed tongue-like appendage in the sinus cavity 3

3a Leaves ovate at stem base, oblong-lanceolate to elongate-ovate above stem base, 6.3 to 25.0mm wide ..... *S. rara*

3b Leaves linear to narrow-lanceolate through out stem, 1.5 to 4.0mm wide 4

4a Proximal appendages to corona-lobes long filiform, pointing up & overtopping the style-apex ..... *S. bicuspis*

4b Proximal appendages to corona-lobes small falcate, sometimes projecting onto the style-apex, but never overtopping it ..... S. *concinna*

1. *Sigridia viridiflora* (E. Mey.) Nicholas. *Comb. nov.* **Type:** *Drége s.n. (V, a)*, South Africa, Eastern Cape province, Zuurberg, on northern mountain sides, 762—915 meters, 30 Oct. 1829 [Holo. B† Iso.K]. *Fida* Goyder 1997.

Pachycarpus viridiflorus E. Mey., Comm. Pl. Afr. Austr.: 214 [1838]. **Type:** As above.

Xysmalobium viridiflorus (E. Mey.) Dietr., Syn. Pl. 2: 903 [1840]. **Type:** As above.

Gomphocarpus viridiflorus (E. Mey.) Decne., in DC. Prodr. 8: 561 [1844]. **Type:** As above.

Asclepias viridiflora (E. Mey.) Goyder, Kew Bull. 52(1): 247—248 [1997]. *Nom. ill.* **Type:** As above.

Gomphocarpus marginatus Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 8 [1894], *non sensu* E. Mey. [1838].

Asclepias dregeana Schltr., in Journ. Bot.: 337 [1895] *nom. nov.* for *Gomphocarpus marginatus* Schltr. non E. Mey.

Discussion: As has been pointed out by Goyder (1997) this species cannot be placed in the genus *Pachycarpus*, from which it differs in its quite different corona-lobe shape and texture, smaller flowers and flower color, and in its indumentum. *S. viridiflora* is widespread and can be divided into two varieties based on whether the corona-lobes are solid (variety *viridiflora*) or have a shallow to deep sinus cavity (variety *calceolus*). We have been unable to uphold the variety *sordida* of Brown (1908) which falls within the variation exhibited by var. *calceolus*. Flowers, although usually brilliant green or green, sometimes also butter-yellow (fig. 13). Interestingly, unlike most other Asclepiadaceae the flowers of this species exhibit a wide size range, varying from 7 to 21mm.

Distribution: Southern African endemic. South Africa [Eastern Cape, KwaZulu-Natal, Mpumalanga, Gauteng & Northern province] and Swaziland. If *Asclepias fulva* N.E. Br. is considered a synonym of this species then in tropical Africa as well.

Key to Varieties:

1a Corona-lobes solid, lacking sinus ..... var. *viridiflora*

1b Corona-lobes not solid but with a shallow to deep cavity-like sinus ..... var. *calceolus*

1a. *Sigridia viridiflora* (E. Mey.) Nicholas **var. *viridiflora***

Discussion: This variety, although, characterized by a corona-lobes which is usually quite solid some specimens (*Wood 350 & Rudatis 574*) possess corona-lobes with an shallow groove down the upper surface, these are, in a sense, precursors of var. *calceolus*. Plants are found growing in short, probably annually burned grassveld. They flower between October and December, and are found at altitudes of 300 to 1200 meters.

Distribution: South African endemic. [KwaZulu-Natal & Eastern Cape provinces only] (fig. 14).

Conservation Status: Vulnerable to threatened in some areas only.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1137 with Norris*, Nkonzo State Forest [CPF]; *Schrire 842*, near Highflats [NH fruit]; *Wylie s.n.*, Greytown [NH 21645]; *Ward 2836*, St. Lucia [NH]; *Rudatis 574 (366)*, Fairfield [STE]; *Wood 350*, Inanda [NH with drawing, SAM]. Eastern Cape: *Daly & Sole 447 (=325)*, Grahamstown [NH]; *Sim 1021*, Pirie [SAM]; *Cruden 242*, Alicedale [GRA]; *Hilliard & Burtt 13176*, Potters Pass [NU, duplicates at E & K not seen]; *Sim 277*, Pirie [NU]; *Flanagan 372*, Prospect Farm [BOL, SAM]; *Pegler 656a*, Kentani [SAM].

1b. *Sigridia viridiflora* (E. Mey.) Nicholas var. ***calceolus*** (S. Moore) Nicholas. *Comb. nov.* **Type:** *Rand 966*, South Africa, Gauteng province, open veld north of Johannesburg [Holo. BM].

Asclepias calceolus S. Moore, in Journ. Bot.: 312 [1903]. **Type:** As above.

Asclepias dregeana Schltr. var. *calceolus* (S. Moore) N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 697 [1908]. **Type:** As above.

Asclepias dregeana Schltr. var. *sordida* N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 697 [1908]. **Type:** *Pegler 655* not of *Aidomene aurea,* South Africa, Eastern Cape province, Kentani. [Holo. K, Iso. BOL, SAM]. Placed in synonomy here.

Discussion: This variety is distinguished by its slightly larger leaves and petals, and different corona-lobes which have a corona-lobe sinus. This sinus can vary from being a shallow but distinct groove, or deep and sac-like. The follicles are also slightly larger. Brown (1908) using a single specimen, distinguished variety *sordida* by its larger petals with dark purple-brown veins, corona-lobes having a deep sinus, upper margin always truncated (the upper proximal and distal ends being about the same height and level with the style-apex), and marked with violet. However, variety *calceolus* exhibits all of these characteristics too and we have, as a result, not been able to uphold var. *sordida*. Plants occur in short, probably annually burned, grassveld and are found at altitudes of between 300 and 1600 meters. Flowering takes place from September to February, peaking in December. Illustrated in Flowering Plants of South Africa (Anonymous 1931).

Distribution South African endemic. [Northern, Gauteng, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] and Swaziland (fig. 14).

Conservation status: Low Risk (Least Concern). Not as often collected now as in the past. It is vulnerable in many parts of its range.

Representative Specimens: South Africa: Northern: *Rogers 18141*, Louis Trichardt [J]; *Sutton 854*, Goedgedacht [PRE]. Gauteng: *HBG (= Gilliland) s.n.*, Modderfontein [J 26889]; *Smith 3402*, Pretoria [PRE]; *Macnae 1386*, Melville Koppies Nature Reserve [J]; *West s.n.*, Frankenwald [J 37693]; *Moss 8675*, Parkview, Johannesburg [J]; *Leendertz 505*, Pretoria [SAM]; *Pole-Evans 12866H*, Kaalfontein [PRE]; *Pole-Evans s.n.*, Willowdene, Pretoria [PRE 50149]. Mpumalanga: *Rudatis 2649*, Wonderhoek [STE]; *Sutton 350*, Lichtenburg [PRE fruit only]; *Thorncroft 1175*, Barberton [PRE]; *Deall 1352*, Sabie area [PRE]. KwaZulu-Natal: *Nicholas 950*, Mooiriver [NU]; *Venter 4979*, Richards Bay [PRE]; *Wood 350*, Inanda [NH, SAM]; *Wood 10820*, Tugela [BOL, NH]; *Wood 1657*, near Durban [NH]; *Wood 10845*, Howick [NH]; *Stewart 2183*, Heidelheim farm near Hilton [NU]; *Wood 11222*, Zwaartkop [NU]; *Franklin 54*, near Umtamvuna [NU]; *Thode 2770*, Kenterton [JF, STE]; *Rennie 284*, Glengariff [NU]; *Compton 23749*, Town Hill, Pietermaritzburg [NBG]; *Thode 2583*, Chakkaskraal [JF, STE]; *Green 472*, Glen Echo [PRE]; *Mogg 2195*, Pietermaritzburg [PRE but not typical in leaves & flowers]; *Wood 11464*, Umzinyati [PRE]. Eastern Cape: *Pegler 656*, Kentani [SAM flowers & fruit]; *Tyson 3113*, Malowe [SAM]. **Swaziland:** *Dlamini s.n.*, Mbuluzi Valley [NH 111132]; *Dlamini s.n.*, Black Mbuluzi Valley [NBG 78392]; *Karsten s.n.*, top of Komati Pass [PRE 31212]; *Dlamini s.n.*, Malkerns [PRE 31211 Corona-lobe sinus a very shallow groove].

2. Sigridia rara (N.E. Br.) Nicholas. *Comb. nov.* **Types:** *Daly 735,* South Africa, Eastern Cape province, near Grahamstown. [Lecto. K, Isolecto. GRA]. Chosen here. *Bolton s.n.*, near Grahamstown [Isosyn. BOL]. *MacOwan 713*, near Grahamstown [Syn. n.v.].

Asclepias rara N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 699 [1908]. **Types:** As above.

Discussion: In its vegetative facie (leaf shape) and flowers structure (especially corona) this species is similar to *S. viridiflora*, however, in its white hairs and flower color it is

somewhat like *Sigridia cultriformis*. Brown (1908) described this species from only three specimens and only one new specimens has come to light since then.

Distribution South African endemic [Eastern Cape province only (in the Albany district)]. (fig. 14)

Conservation Status: Critically endangered. The Albany area is extensively farmed, has a very high human population and has been severely affected by drought. This species has only been recollected once in almost a century.

Representative Specimens: South Africa: Eastern Cape: *AWE & RDA Bayliss 4417,* Coombs Valley [PRE].

3. *Sigridia cultriformis* (Harv. ex Schltr.) Nicholas. *Comb. nov.* **Type:** *Wood 405,* South Africa, KwaZulu-Natal, Inanda, 548 meters, Jan. 1885 [Lecto. NH]. *Barber s.n.*, South Africa, without precise locality [*n.v.*].

Asclepias cultriformis Harv. ex Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 31 [1894]. **Types:** As above.

Discussion: Like *Aidomene humilis*, when encountered in the field, this is one of those species that can't fail to amaze. *S. cultriformis* is unusual in the genus because it possesses a small vertical tongue-like appendage which is hidden within the sac-like corona-lobe sinus. Corona-lobes are also generally much larger than in the other species (fig. 13). Plants are found growing in open, usually annually burnt grasslands, often occurring on very stony or boulder strewn slopes. Flowering occurs from November to February, and plants may be found at altitudes of between 450 and 2380 meters. The Zulu hang bundles of roots in the roof of huts where they are preserved by smoke, pieces are then burned during bad storms to ward off lightening (Hulme, 1954). The Zulu name is *ishongwe-eluhlaza* (Hutchings, 1996). Illustrated in Wood (1912).

Distribution Southern African endemic. South Africa [Northern, Gauteng, Mpumalanga, KwaZulu-Natal and Eastern Cape provinces] and Swaziland (fig. 14).

Conservation Status: Vulnerable in many areas.

Representative Specimens: South Africa: Northern: *Junod 4286*, Pietersburg [PRE];

Figure 13. *Sigridia viridiflora*: a. & b. Whole plant showing habit; c, d & e. close up of flowers. *S. cultriformis*: f. Whole plant showing habit; g. Close up of flowers. Photographs: a, c, e & f by A. Nicholas; b & d by M. Von Fintel, g by T. Abbott.

Reid 1161, Orrie Baragwanath Pass [PRE]; *Mogg s.n.*, Woodbush [PRE]. Gauteng: *Bredenkamp 534*, Suikerbosrand Nature Reserve [PRE]; *Haagner s.n.*, Modderfontein [GRA]; *Moss 8571*, Parkview [J]. Mpumalanga: *Thorncroft 1181*, Lomati Valley [PRE]; *Theron 2453*, Chrisiemeer [PRE]; *Pole Evans 4726*, Machadodorp [PRE]; *Cameron 93*, Dullstroom [PRE]; *Acocks 16610*, Middleburg [PRE]; *Thorncroft 689*, Barberton [NH]; *Rogers 14990*, Barberton [J]; *Wicht 68*, Highwoods, Belfast [STE]; *Collins 6343*, Ermelo [GRA]. KwaZulu-Natal: *Nicholas 1043*, near Gillits [NH]; *Nicholas 2729*, Sunset Farm, near Underberg [UDW]; *Wood 11973*, Krantzkloof [NH]; *Moll 5143*, Coleford [NH]; *Rennie 430*, Glengariff, Marwaga lot 5 [NU]; *Wood s.n.*, Pinetown [SAM 18550]; *Smith 3506*, Nottigham Road [PRE]; *Bews 14*, Himeville [PRE]; *Werdermann & Oberdieck 1445*, Sani Pass [BO, PRE photo]; *Ross 1876*, Wicmann's Farm, near St. Michaels-on-sea; [NH, PRE]; *Haygarth ex Wood 7586*, Zululand [SAM]; *Lawn 1445*, Eshowe [NH]; *Strey 4594*, Hlinza Forest near Eshowe [NH]; *Coleman 18*, Everton [NH]; *Hariss 135*, Retirement Farm, Utrecht [NU]; *Wood 10833*, Howick [NH]. Eastern Cape: *A & G Hutchings 1908*, York Farm, Thaba Chitja [KEI]; *Bowker/Barber 831*, Tsomo [GRA, NH possibly isosyntypes]; *Hutton s.n.*, Shafton, Howick [GRA]; *Taylor 5540*, Inungi Farm, near Palmiet Mt Currie [NBG]; *Stewart 1936*, near Maclear [NU]; *Schlechter 4005*, Elandspruitberg [BOL, GRA]. **Swaziland:** *Burtt Davy 2758*, Mbabane [PRE]; *Compton 23812*, Mbabane [NBG].

4. *Sigridia bicuspis* (N.E. Br.) Nicholas. *Comb. nov.* **Type:** *Fannin 50,* South Africa, KwaZulu-Natal, Dargle Farm [Holo. K. Iso. BOL part of type] (fig. 15).

Asclepias bicuspis N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 675 [1908]. **Type:** As above.

Discussion: This species is similar to *S. cultriformis* in its corona-lobe structure, but it differs from this species in a number of characteristics; see table 4. Plants grow in annually burned grassveld (including firebreaks), in full sun and well drained soil. Flowers are greeny yellow, scentless and are produced between October to November.

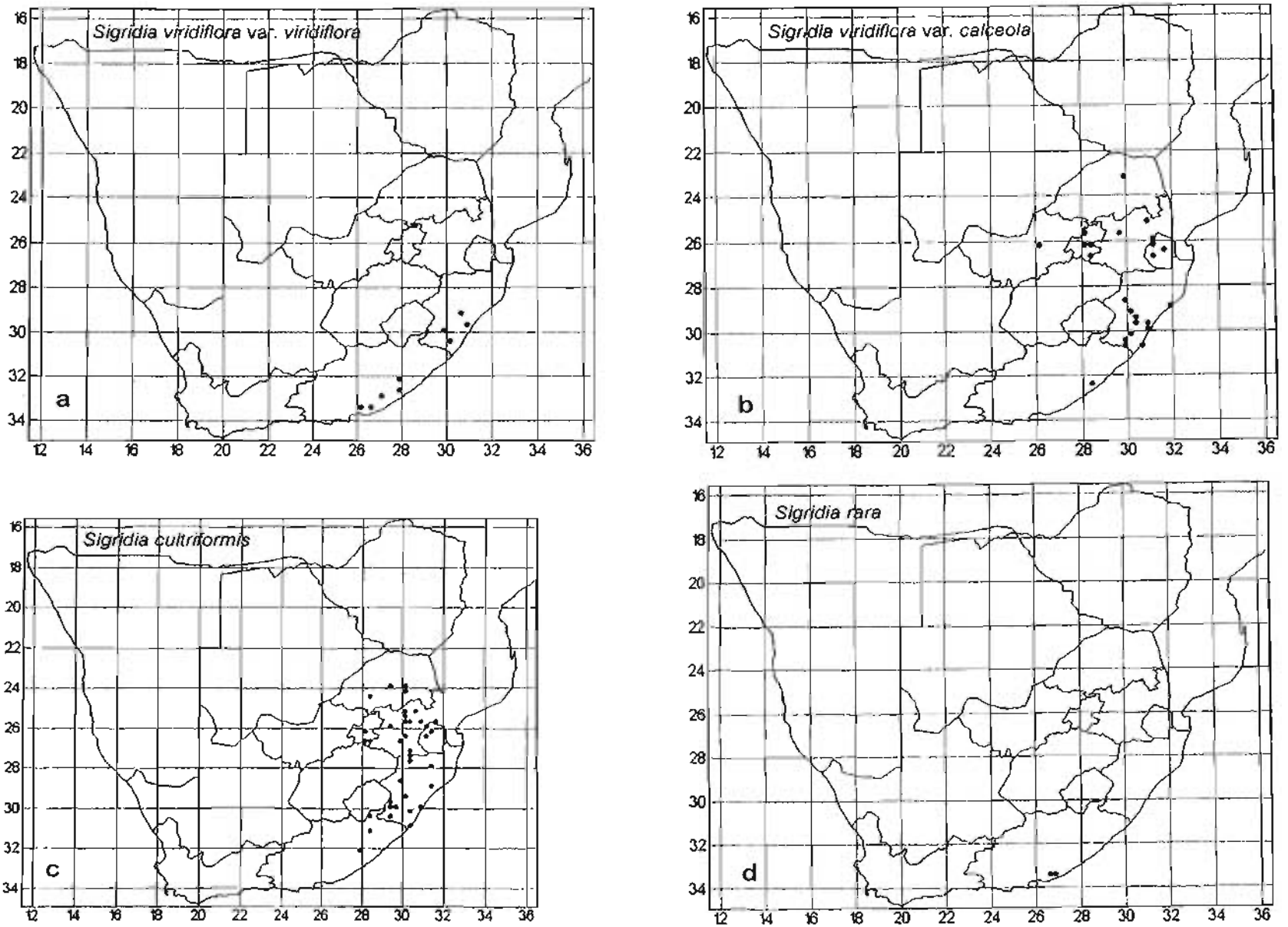


Figure 14. Distribution maps of: a. *Sigridia viridiflora* var. *viridiflora*; b. *S. viridiflora* var. *calceola*; c. *S. cultriformis* and; d. *S. rara*.

Table 4: List of differences between *S. cultriformis* and *S. bicuspis* (all measurements in mm)

Characters	*S. cultriformis*	*S. bicuspis*
Leaf shape	Oblong-linear to ovate lanceolate	Usually linear, rarely narrow-lanceolate
Leaf base	Rounded to subcordate	Tapering
Leaf length	25 to 50	30 to 110
Leaf width	6.5 to 16	1.5 to 4.0
Sepal length	6.5 to 9.0	2.5 to 3.0
Sepal width	2.0 to 3.5	±1.0
Petal shape	Ovate	Ovate to narrow-elliptic
Petal length	12 to 15	5.5 to 6.0
Petal width	7.8 to 11.5	2.5 to 3.2
Corona-lobe height	2.0 to 4.5	3.4 to 3.7
Corona-lobe width	2.0 to 4.5	±1.2
Corona-lobe sinus appendage	Present	Absent
Anther-appendage shape	Broadly ovate	Reniform or wing-like

Distribution: South African endemic [KwaZulu-Natal province only] (fig. 15).

Conservation Status: Critically Endangered. This species is only known from three collections, two of them made almost a hundred years ago in the Dargle-Howick area of the Natal midlands. Although several failed trips were made by the senior author to this area to recollect this species, it was fortuitously recollected by T.R. Greene in October 1998; even then it is said by him to be rare and only one plant was pressed. The area in which it occurs has been heavily impacted on by agriculture, aforestation, the building of the large Midmar Dam and ever increasing urbanization. There are few natural areas left and the future survival of this species is doubtful.

Representative Specimens: South Africa: KwaZulu-Natal: *Haygarth s.n.*, above Howick [NH 12338]; *Greene 1050*, Wahroonga farm, Merrivale area [NH].

5. *Sigridia concinna* (Schltr.) Nicholas. *Comb. nov.* **Type:** *Wood 7167,* South Africa, KwaZulu-Natal interior, without precise locality [Lecto. NH]. Chosen here. *Schlechter 6418*, South Africa, Eastern Cape province, near Tina River [Syn. *n.v.*].

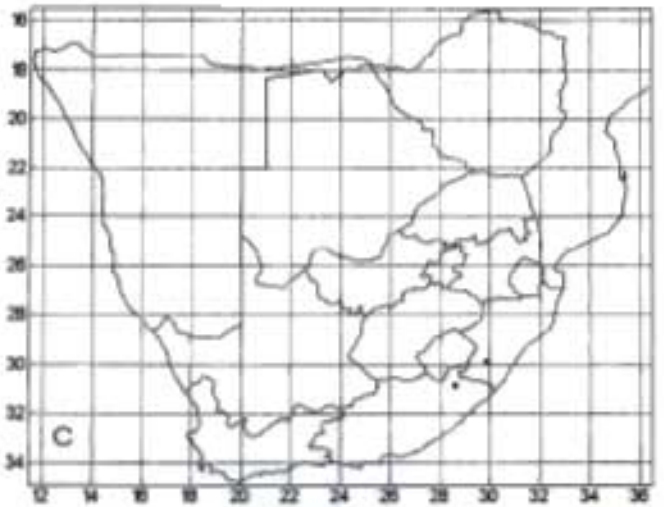
Gomphocarpus concinnus Schltr., in Journ. Bot.: 33: 270 [1895]. **Types:** As above.

Asclepias concinna (Schltr.) Schltr., Journ. Bot. 34: 456 [1896]. **Types:** As above.

Discussion: Specimens of this species were unknown to Brown (1908) and he placed it under a section headed "Imperfectly known Species". We find this species to be distinct. After a gap of almost 100 years the senior author had the good fortune to recollect this species in 1981. In the field it is a delicate and somewhat inconspicuous looking plant, unlike *S. cultriformis*. Also, unlike *S. cultriformis* the inflorescences are completely pendulous with the flowers facing down. Schlechter (1985) said that it is a "... distinct plant, very unlike anything we know of the genus on the African continent." This is to a degree true, however, in its overall facie and structure it most resembles other species in *Sigridia* and we have placed it here (fig. 15). Possible this can be retested when further data on this species comes to light, however, this will need to be done before it becomes extinct; a condition it is unfortunately close to. We have been unable to trace the Schlechter specimen (one of the two isotypes cited in the protologue), but have seen the a duplicate of the other (isosyntype) which we have selected as the isolectotype. This species can be found growing in annually burned midland grassveld (fig. 15). Plants flower from about October to December and occur at altitudes of about 900 to 1500 meters.

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape provinces] (fig. 15).

Conservation Status: Critically Endangered. When originally described this species was only known from two collections: One by Medley Wood, from somewhere in KwaZulu-Natal, and one by Schlechter, from near the Tina River in the Eastern Cape. Since then (almost 100 years) it was not found again, until 1981, when it was recollected at Nkonzo State Forest. This species is very rare and occurs in areas which are heavily grazed or under pine plantation. Scott-Shaw (1999) classifies this as Endangered.



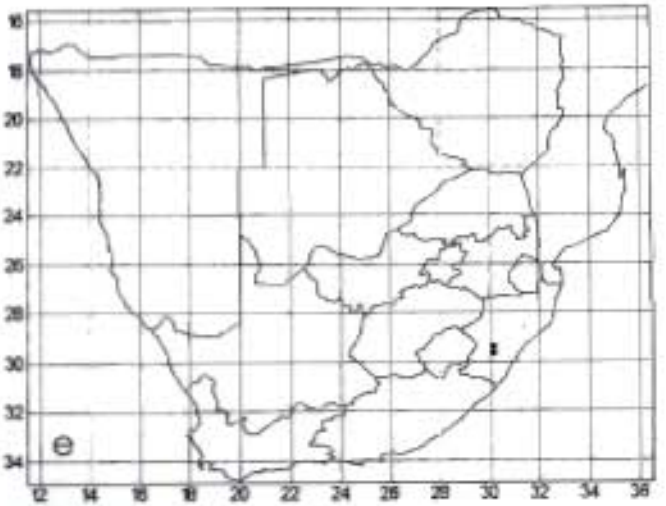


Figure 15. *Sigridia concinna*: a. Whole plant showing habit (300mm tall); b, Close up of flowers; c. Distribution. *S. bicuspis*: d. Isotype (fragment), Fannin 50 (BOL); e. Distribution. f. Expanding pine plantations at Nkonzo in the Natal Midlands (the home of the only known extant population of *S. concinna*) threating this and other grassland species with extinction: Photographs by A. Nicholas.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1172 with Norris*, Nkonzo State Forest [CPF, PRE] Eastern Cape: *Schlechter 6418*, near Tina River [*fide* Brown 1908 *n.v.*].

BRUYNSIA Nicholas, *gen. nov.* *Affinitas obscura.* ***Radi*** *caudex unicus, gracilis, carnosus.* ***Caules*** *2—20, decumbentes, 100—450mm longi.* ***Folia*** *linearia, lanceolata, vel triangularia; lamina 0.5—10.5mm longa, 0.8—9mm lata.* ***Inflorescentia*** *terminalis, solitaria, arrecta, 1—18 in plante.* ***Flores*** *4—16 in inflorescentia, virides, lilacini, rosei vel albidi.* ***Coronae lobi*** *turriformes, valde longiores (4—13mm) latis (0.9—2.8mm).* ***Androecium****: Anthera-alae margine cum incisura distincta.* ***Gynoecii*** *apex applanatus vel brevissimus conicus.* **TYPUS:** *Bruynsia brevicusis* (E. Mey.) Nicholas, *vide infra.*

Description: *Habit*: small, perennial, geophytic herbs, with milky latex. *Underground-organ* a deep-seated, thin, but fleshy stem-tuber. *Stems* (2-)4–12(-20), decumbent, 100—450mm long, flattened & channelled from the base, rarely glabrous at the base, scabrous to pubescent, bifarious. *Leaves* opposite, simple, entire, spreading to spreading ascending; blades linear to lanceolate, occasionally triangular, narrowly ovate or falcate, (5-)8—100(-132)mm long, (0.8-)1.0—9.0mm wide, older leaves shorter & broader, apex sharply acute to acute, base hastate, shortly auriculate, trullate, truncate or slightly oblique, margin smooth, slightly revolute, adaxial venation not prominent, abaxial venation only midrib & occasionally 2° lateral veins prominent; petioles 0.3—8.0(-10.0)mm long. *Inflorescences* 1—18 per plant, umbel-like, terminal, solitary, erect, 4—16-flowered; peduncles (4.2)10.0—48.0(-67.0)mm long, puberulous, scabrous, pubescent, tomentose, rarely glabrous, ubique to unifarious; bracts linear-triangular, linear, triangular to narrow-lanceolate, (1.0-)2.5—7.7(-12.0)mm, 0.1—1.0mm wide, abaxial surface glabrate, scabridulous, scarbrous to puberulous, margin scabridulous, scarbrous to ciliate, usually present at anthesis, ocassionally fugaceous. *Flowers* 5—27mm long, 7—28mm wide, rotate to reflexed, purple, pink, greenish mauve to lilac, green &/or white; pedicels (0.8-) 1.0—20.0(-28.0)mm long, pubescent to tomentose, hairs ubique to unifarious. *Calyx* 5-merous; lobes narrow-lanceolate, lanceolate, occasionally triangular, 3—9.5mm long, 0.7—2.8mm wide, apex sharply acute to acute, adaxial surface glabrous, abaxial surface

puberulous to pubescent, rarely glabrous, margins scabrous to puberulous, green with tips purple. *Corolla* 5-merous, spreading–erect, spreading to reflexed, divided almost to base; lobes lanceolate, ovate, narrow-ovate to narrow-elliptic, (1.5-)6.5—12.0(-20.0)mm long, (1.2-)2.5—4.8(-5.6)mm wide, apex acute, margins sometimes revolute, adaxial surface glabrous, abaxial surface glabrous to glabrate, sparsely strigose or sericeous, margins scabridulous. *Staminal-corona* 1-seriate, 5-merous, arising at the gynostegial-colum base; lobes erect, turriform, much taller (4—13mm) than broad (0.9—2.8mm), laterally compressed, upper proximal ends obtusely rounded, shoulder–like occasionally folded inwards, lower than, level with or greatly overtopping the style-apex, upper distal end obtuse, raised slightly, a deltoid point or subulate & 1.2—2.8mm long appendage flexed inwards & sometimes outwards, level with or greatly overtopping the style-apex, upper margin truncate, shallowly concave, or concavely sloping downwards, outer keel rounded, gibbous in the middle or sinuous, inner margin shallowly concave, vertical or sinuous, sinus a narrow central channel with or without a central tongue-like appendages or empty but obstructions with an apical flap. *Staminal-column* 3.0—4.5(-6.5)mm tall; anther–wings (1.1-)1.7—2.5(-3.8)mm long, 0.4—1.2(-1.4)mm wide, wider at base than apex, slightly curvirostrate with a distinct notch on the margin (position varies greatly); anther–appendages leaf–like, ovate, occasionally narrow-elliptic or triangular, 0.7—1.7(-2.2)mm long, 0.8—1.7(-2.0)mm wide, apex acute, decumbent on the style-apex margin. *Style-apex* 1.0—3.3mm in diameter, shortly conical to truncate & with a central concave pit. *Pollinaria:* Pollinia solitary & pendulous, obclavate to lacrimiform, often large, 1—2.4mm long, 0.4—0.7mm wide; translator–arms usually twice geniculate & with broad transparent margins, joining the pollinium apically; corpusculum diamond-shaped. *Fruit:* 1 by abortion, erect, fusiform, (50-)74—105(-122)mm long, 6—15mm wide, apically & acutally beaked, smooth, glabrous or minutely scabrous, beaked at the apex; fruiting peduncle & pedicel straight. *Seeds*: Obovoid, dorso-ventrally flattened, 4—4.4(-6.1)mm long, 1.6—2.1(-4.5)mm wide, 0.8—1.0mm deep, abaxial surface shallowly convex, adaxial surface shallowly concave, margin large & wing-like, surface farinaceous, brown to light brown. *Etymology:* This genus is named in honour of Dr Peter Bruyns, a South African taxonomist who has contributed widely and significantly to the systematics of the Asclepiadaceae; particularly in Africa but also extra Africa.

Discussion: In 1956, Bullock transferred *Asclepias eminens* to the genus *Stenostelma* Schltr. However, although the two are probably fairly closely related data, collected during work presently being undertaken on the southern African members of the subtribe Asclepiadinae, has highlighted important generic differences between *A. eminens* and its allies and those species that presently comprise the genus *Stenostelma*. (Table 5). The vegetative facie of the genus *Bruynsia* is unlike most other genera in southern Africa. In particular, the habit, leaf morphology and texture (see generic description) are, in combination, unique. The nature of the corona, which has turret-like, fleshy lobes with a central sac-like or furrow-like sinus with or without a sinus appendage, is unparalleled. Also of interest is the notch-like kink in the anther-wings or gynostegial-groove well above their base, however, this phenomenon, although not common, is of limited occurence being found in some *Stenostelma* species. As Dr Bruyns has pointed out to us (pers. com.) this notch and its unusual position is probably associated with the very distinct knee on the translator-arm which enters it and drags the pollinium into the gynostegial groove.

Based on the above unique correlated set of characteristics, *A. gibba* and its allies can be seen to form a group distinct from any other in the subtribe Asclepiadinae; including *Stenostelma*. As a result, we have chosen to erect the new genus, *Bruynsia*, for them. This genus consists of eight species which can be divided into two sections: *Bruynsia* and *Cryptoglossa*. Interestingly, within this genus hybridization is (for the Asclepiadaceae at least) frequent. This hybridization seriously questions whether the so called "lock-and-key" mechanism of asclepiad *in situ* pollination is really as species specific as the literature tends to suggest. However, the anther-wings in this genus are fairly similar in both structure and size throughout possibly suggeting that any lock-and-key mechanism operates at the generic rather than at the specific levels. However, this is all speculative as the reasons for widespread hybridization in one genus and not another can be varied and some such as *Drosera* may actually have genetic mechanisms to promote hybridization (Nicholas & Kondo, in press). Hybridization can be advantageous under some conditions and can promote reticulate evolution and so speciation.

Distribution: South central African endemic. From the Eastern Cape Province in South Africa along the eastern half of the subcontinent to Zimbabwe.

TABLE 5: List of characters that separate *Bruynsia* from *Stenostelma*.

Character	*Bruynsia*	*Stenostelma*
Stems	2.0 to 20	1 to 10
Inflorescences	Terminal	Terminal & Extra-axillary
Flower Orientation	Erect	Erect to Pendent
Corolla Shape	Reflexed or catiliform, not constricted just above the middle	Globose campanulate, constricted just above the middle
Corolla Synorganization	Free to the base	Free to the base or fused to 50% of its length
Petal orientation	Reflexed or spreading erect	Erect
Corona Type	Tower-like/Turriform	Leaf-like/Lamina

Key To The sections:

1a Petals reflexed. Corona-lobe sinus without a compressed tongue–like appendage or transverse flap or hood of tissue near the apex ..... section *Bruynsia*

1b Petals spreading erect. Corona-lobe sinus with a compressed tongue–like appendage or transverse flap or hood of tissue near the apex ..... section *Cryptoglossa*

BRUYNSIA Section ***BRUYNSIA***

Description: *Stems* 1–10(-28), 120—450mm long. *Leaves*: Blade linear to lanceolate, occasionally narrowly trullate, linear-triangular, triangular, narrowly elliptic or falcate, (5-) 11—100(-132)mm long, 0.2—9.0mm wide.; petioles 0.4—9.0mm long. *Inflorescences* 1—12(-18) per plant, 4—13-flowered; peduncles (4.2-)7.0—67.0mm long; bracts linear-triangular, linear, triangular to narrow-lanceolate, (1.0-)2.8—9.0(-12.0)mm, 0.2—1.0mm wide. *Flowers* 5—27mm long, 7—28mm wide, rotate to reflexed; pedicels (6-)10—28mm long. *Sepals* 3.0—9.5mm long, 0.7—2.8mm wide. *Petals* spreading to reflexed, ovate, (1.5-)6.5—13.0(-20.0)mm long, (1.2-)2.5—6.0mm wide, apex sharply acute to acute, margins sometimes revolute & sinuate. *Corona-lobes* 4—13mm tall, 0.9—2.8mm wide, upper proximal ends obtusely rounded, shoulder–like

occasionally folded inwards, lower than, level with or greatly overtopping the style-apex, upper distal end obtuse, raised slightly, a deltoid point or subulate & 1.2—2.8mm long appendage which is flexed inwards or sometimes outwards, level with or greatly overtopping the style-apex, upper margin truncate, shallowly concave, or concavely sloping downwards, outer keel rounded, gibbous in the middle or sinuous, inner margin shallowly concave, vertical or sinuous, sinus a narrow central channel without a central tongue-like appendages or apical flap. *Staminal-column* 4.0—6.5mm tall; anther–wings (1.1-)1.7—2.5(-3.8)mm long, 0.4—0.8mm wide; anther–appendages leaf–like, ovate, triangular, ocassionally narrowly elliptic, 0.7—1.7(-2.2)mm long, 0.8—1.6(-2)mm wide. *Style-apex* distinctly conical, being narrower at the top than at the bottom, diameter 1.3—3.6 at base, 0.6—2.9mm at top & with a central concave pit at the top. ***Fruit:*** (50-)74—100(-122)mm long, 6—15mm wide. *Seeds:* 4—6.1mm long, 1.6—2.1(-4.5)mm wide, 0.8—1.0mm deep.

Discussion: The section *Bruynsia* is distinguished by the lack of a tongue-like appendage or apical plate of tissue in or blocking the slit-like sinus.

Distribution: Widespread in the summer rainfall region from the Eastern Cape Province (South Africa) to Zimbabwe.

Key To Species

1a. Petals never more than 5mm long ..... *Bruynsia sp.*

1b. Petals always more than 6mm long 2

2a. Upper proximal edges of the corona-lobe forming an obtuse shoulder that is level with the middle of the anther–wings & below the level of the style-apex ..... *B. capitata*

2b. Upper proximal edges of the corona-lobe forming an obtuse shoulder that is not level with the middle of the anther–wings, but which is level with or higher than the style-apex 3

3a. Upper proximal margin of corona-lobes taller than the style-apex by 2mm or more 4

3b. Upper proximal margin of corona-lobes level with or over-topping the style-apex by no more than 1mm 5

4a. Corona-lobes 10—15mm tall (rarely as short as 9mm). Gynostegial–groove 2.8—3.6mm long ..... *B. eminens*

4b. Corona-lobes 5.8—9.6mm tall. Gynostegial–groove 2.2—2.8mm long ..... *B. xmedia*

5a. Upper distal corona-lobe appendage distinctly subulate, 1.3—3.0mm long. ..... *B. gibba*

5b. Upper distal corona-lobe appendages absent, although the distal end of the corona-lobe may be produced into a blunt or pungent point that is 0.5—1.0mm long ..... *B. brevicuspis*

1. ***Bruynsia capitata*** (schltr.) Nicholas. Comb. Nov. **Type:** *Schlechter 3905,* South Africa, Mpumalanga province, Crocodile River. [Holo. B†. Iso. PRE x2].

Schizoglossum capiatatum Schltr. In Engl., Bot. Jahrb. 20(5). Beibl.51: 15. **Type:** As above.

Asclepias dissona N.E. Br., in Thiselton-Dyer, Fl. Cap. 4(1): 681 [1908]. **Type:** *Schlechter 3903,* South Africa, Mpumalanga province, Crocodile River. [Holo. K. Iso. BOL, NH, GRA, PRE] (fig. 20).As above.

Discussion: there are two type specimens at PRE, on one of them someone (not Schlechter) has penciled in the number 3905 (the type of *S. capitatum*), whether this was done in error and the number was meant to be 3903 (the type of *A. dissona*) we will probably never know. As a result, we must assume that this is what it says and S. capitatum must take priority over *A. dissona* as the basionym. N.E. Brown only saw Schlechter's original drawings of the flower at BOL and maintained it in *Schizoglossum*. Both Schlechter's and Brown's descriptions (especially of the corona-lobe) fit better with

what was *Schizoglossum* than what was *Asclepias*. Nevertheless, Schlechter's specimens numbered 3903 and 3905 that we have seen are exactly the same and we have assumed them to be conspecific; even if the descriptions suggest otherwise. Also, Schlechter on the type specimens of *A. dissona* has written *Gomphocarpus umbellatus Sp. Nov.*, but this name was never taken up.

Brown (1908) has pointed out the similarity of this species to both *B. brevicuspis* and *B. navicularis*, to an extent there is also a close resemblance to *B. gibba*. However, it differs from all of these in its distinct floral morphology, especially corona-lobe structure. The corona-lobes are claw-like rather than turriform, the upper proximal ends are below the style-apex and about level with the middle of the anther-wings, the upper margin then slopes up to the dentately pointed upper distal end which is level with the style-apex, the keel is distinctly rounded. The corona-lobe to an extent resembles that of *B. disparilis*, but it differs in that the upper margin is not obliquely truncated and sinuous and there is no inner flap of tissue blocking the top of the sinus. *B. disparilis* also has broader leaves. Other differences include the convex anther-wings which are slightly squared on the leading edge and have a notch near the apex rather than near the base (is in most other species of this genus). The pollinia are club-like being dilated at the base, soon narrowing to the apically attached translator-apparatus. Vegetatively it is the same as other species of this genus. Plants flower in December, with one record each in October and November, and occurring at altitudes of between 1400 and 1560 meters. This species grows in moist soils near rivers, on grass hillsides and in ungrazed road reserves. Illustrated in Nicholas (1981 & 1987).

Distribution: South African endemic [Mpumalanga province only] (fig. 19).

Conservation Status: Endangered. *B. captata* is a rarely collected species of limited distribution; it has not been recollected for over 30 years. It also occurs in an area of extensive agriculture and commercial aforestation.

Representative Specimens: South Africa: Mpumalanga: *Rademacher 9593*, Carolina [GRA, PRE]; *Galpin 12979*, Machadodorp [PRE]; *Burtt 3106*, Machadodorp [NU].

2. ***Bruynsia gibba*** (E. Mey.) Nicholas. *Comb. nov.* **Type:** *Drége 4973,* South Africa, Eastern Cape province, Witbergen. [Holo. B† Iso. P]. Chosen here. Not *Drége 4973* from between Umtata and Umzimvubo; sometimes also cited as *Drége 4967* (fig. 20).

Lagarinthus gibbus E. Mey., Comm. Pl. Afr. Aust.: 204 [1838]. **Type:** As above.

Gomphocarpus gibbus (E. Mey.) Dietr., Syn. Pl. 2: 9 [1840]. **Type:** As above.

Asclepias gibba (E. Mey.) Schltr., in Engl., Bot. Jahrb. 21 (5). Beibl. 54: 7 [1896]. **Type:** As above.

Lagarinthus gibbus E. Mey. var. β, Comm. Pl. Afr. Aust.: 204 [1838]. **Type:** *Drége s.n. (V, b),* South Africa, Eastern Cape province, between Umtata & Umzamvubu, in grasslands, 1500–2000ft (= 305–610m) [*n.v.*].

Gomphocarpus oxytropis Turcz., in Bull. Soc. Nat. Mosc. 1: 259 [1848]. **Type:** *Ecklon 28,* South Africa, Eastern Cape province, near Shiloh. [Holo. *n.v.* Iso. Mel *fide* Forster, 1993, *n.v.*].

Asclepias oxytropis (Turcz.) Schltr., J. Bot., Lond. 34: 454 [1896]. **Type:** As for *Gomphocarpus oxytropis.*

Discussion: Although we have not seen the type of *Gomphocarpus oxytropis* (viz. *Ecklon 28*), N.E. Brown (1908) did see it and concluded that it was conspecific with *S. gibbus.* Judging from Turczaninow's (1848) description we have to concur. This species is widely distributed on the eastern side of the subcontinent (fig. 19). Morphologically this species varies a great deal over its distribution range. In the Eastern Cape Province specimens bear some similarity to *B. navicularis.* In these specimens the leaf bases are more petiolate and rarely auriculate, the flowers are pink rather than gray-green tinted purple, the upper distal subulate appendage is reflexed away from the flower center rather than towrads it, the stems are less hairy, more succulent and shorter. This superficial similarity reflects convergent evolution, introgressive hybridization or the lateral transfer of genes. There are specimens indicating that *B. gibba* hybridizes with *B. naviuclaris, B. brevicuspis* and *B. xmedia.* In KwaZulu-Natal *B. gibba* and *B. brevicuspis* may at first appear sympatric, but *B. gibba* tends to be found in sandy situations; in habitat preference the two taxa are allopatric despite their close geographical proximity. Occasionally hybrid specimens are encountered but this is not common; these are cited later. Plants along parts of the KwaZulu-Natal, Free State, Mpumalanga and Swaziland Drakensberg

watershed (**Free State:** *Junod 17513*, Witzieshoek [PRE]. **Mpumlanga:** *Mogg 11398*, Nooitgedacht [PRE]; *Devenish 1237*, Wakkerstroom [PRE]. **Swaziland:** *Karsten s.n.*, Forbes Reef [NBG 55705, NH 111139 & PRE 49848]) are much more robust than elsewhere. These plants have more stems per plant (these often being longer in length), parts are noticeably more glabrous, the leaves are longer and broader, flowers are larger and greener, and the pollinaria longer. Flower color varies greatly, not only over the entire range but also within populations. *B. gibba* can be distiguished from other species within the genus by its distinct corona-lobe structure, the upper proximal ends being rounded and level with the style-apex, the upper distal end is long, pointed and subulate and exceeds the style-apex, the sinus is a shallow ridge without appendages or flap-like constrictions (fig. 16). The Zulu, who call this plant *umanqanda*, powder the dried roots which they then lick from the back of the hand as a treatment for snakebite. Apparently it causes the victim to vomit and bring up foam which is believed to be caused by the snake bite and the ultimate cause of death if it is not purged (Hutchings, 1996 & Hulme, 1954). The Sotho eat the rootstock (Watt & Breyer-Brandwijk, 1962). Apparently young children pluck the nectar laden flowers which are then chewed as sweets. This species is found growing in open burned or unburned grasslands or in sparsely wooded thornveld. Generally in situations protected from grazing, such as road reserves. Flowering November to February and occuring at altitudes of between 20 to 2500 meters (this is one of the few South African species that occurs from almost sea level to the Drakensberg summit). Illustrated in Nicholas (1981 & 1987).

Distribution: Southern African endemic. Lesotho, South Africa [Northern, Mpumalanga, Gauteng, Free State, KwaZulu-Natal & Eastern Cape provinces], and Swaziland (fig. 19).

Conservation Status: Vunerable in some areas only.

Representative Specimens: Lesotho: *Coetzee 528*, Liseleng valley [BLFU]; *Ruch 2464*, Mokhotlong [PRE]; *Dieterlan 365*, Leribe [SAM]; *Smook 7099*, near Thabatseka [PRE]; *Jacot Guillarmod, Getliffe & Mzamane 120*, Sehlabathebe [GRA]. **South Africa:** Northern: *Methuen 8807*, Zoutpansberg [PRE]. North West: *Germishuizen 566*, Buffelskloof [PRE]. Gauteng**:** *Nicholas 2795 with Baijnath & Singh*, near Suikkerbossie Rand Nature Reserve [UDW]; *Gilliland 26903*, Boksburg south [J]; *Stery 3936*, Pretoria [PRE]; *Young 1320*, Bronkhurstspriut [J]; *Potts 3876*, Vereeniging [GRA]; *Thode 2773*,

Pretoria [JF, STE]; *Mogg 44737*, Onderspoort [SAM]; *Germishuizen 463*, Willows, Pretoria [PRE]. Mpumalanga: *Potts 3661*, Bethal [GRA]; *Thode A2837*, Zondagsfontein, Witbank [NH, PRE]; *Turner 1137*, Koppies Kraal farm, Uitspanning [PRE]; *Codd 4709*, near Ermelo [PRE]. Free State: *Nicholas 2778 with DC Nicholas*, between Bloemfontain & Ficksberg [UDW]; *Spies s.n.*, Clocolan [BLFU 7894]; *Gillett 1103*, Between Verheerde Vlei & Bloemfontein [NH]; *Potts 3102*, Fouriesburg [PRE]; *Spies s.n.*, Clocolan [BLFU 7894]; *Acocks 23837*, Rosendal commonage [PRE]; *Jacobs 172*, Rensbergskop Farm, near Swineburne [NGB]; *Potts 3872*, Trompsburg [BLFU]; *Moraile 3569*, Lambon's Plantation, Bloemfontein [BLFU]; *Pont 477*, Kroonstad [PRE flowers & fruit]; *Welman 62a*, Bloemspruit farm, between Dewetsdorp & Smithfield [PRE]; *Turner 1292*, Vaalpoort farm, Latemanek [PRE]; *Retief 1093*, Farm Rietspruit, near Frankfort [PRE]; *Retief 916*, Sweet Home, near Reitz [PRE]; *Blom 220*, Loch Athlonedam [PRE]. KwaZulu-Natal: *Nicholas 942 with Ackhurst*, Pietermaritzburg [NU]; *Nicholas 959*, Near Champagne Castle hotel [NH, NU]; *Nicholas 965*, Giant's Castle Game Reserve [NH, NU]; *Nicholas 968 with G. Nicholas*, Tabamhlope [NU]; *Nicholas 972*, Near Estcourt [CPF, MO, NU]; *Nicholas 1008*, between Richmond & Ixopo [NH, NU]; *Nicholas 1021 with Stewart*, Hiddelheim Farm, Hilton [NH flower & fruit, NU]; *Nicholas 1023*, Midmar Dam [CPF, K, KRW, NH flower & fruit, NU, PRE]; *Nicholas 1049*, Near Camperdown [NU]; *Nicholas 2038*, Broteni [NH]; *Fannin 46*, "near" Port Natal [TCD]; *Barker 5135*, Richmond [NBG]; *Ngwenya 646*, between New Hanover & Sevenoaks [NH]; *Kok & Pienaar 1204*, near Middlerest [PRE]; *Manning & Balkwill 352*, Lanner Veane farm, near Mooiriver [NU]; *Manning 640*, Ladysmith, Biggarsberg [PRE]; *Rudatis 1774 ex Thode 2570*, Kenterton [JF, STE]; *Hilliard & Burtt 19045*, Cedarville farm, Colchester [NU]. Eastern Cape: *Nicholas 904a*, Shelley Beach [NU, PRE]; *Nicholas 2800 with DC Nicholas*, Gubu Dam [UDW]; *Nicholas 2824 with DC Nicholas*, Kei Mouth [UDW]; *Nicholas 2827 with DC Nicholas*, between Komga & Stutterheim [UDW]; *Nicholas 2838 with DC Nicholas*, Joubert Pass [UDW]; *Rogers 12762*, Stutterheim divison [J]; *Carter 25*, East London [DKH]; *A & G. Hutchings 1889*, Ongeluk's Nek [KEI, PRE]; *Phillipson 775*, near Iron Rock, Amatole mountains [PRE, UFH]; *Mottley 2553*, East London [J]; *Sim 1307*, King Williams Town [GRA, NU,SAM]; *Dold 607*, Nqabe river mouth, Beechamwood, Gatyana [GRA]; *Flanagan 397*, Komga [BOL, GRA, PRE, SAM]; *Giffen*

Figure 16. *Bruynsia brevicuspis*: a. & b. Close up of flowers; c. Whole plant showing habit. *B. gibba*: d. & e. Close up of flowers; f. Plant with fruit; g. Whole plant showing habit. Photographs: a to f by A. Nicholas and; g by M. Kunhardt.

1156, Juanasberg, Fort Beaufort [UFH]; *Dold 1991 with Cocks*, Beddgelert Farm, Witteberge [GRA]; *Coleman 522*, Kokstad [NH, SAM]; *Compton 17702*, Butterworth [NBG]; *Germishuizen 1222*, Hole-in-Wall [PRE]; *Acocks 20099*, King Williams Town [PRE].

3. ***Bruynsia xmedia*** (N.E. Br.) Nicholas. *Comb. et stat. nov. Specei hybridis.* **Type:** *Burtt Davy 795,* South Africa, Gauteng province, Pretoria. [Holo. PRE. Iso. NH].

Asclepias gibba (E. Mey.) Schltr. var. *media* N.E. Br., in Thiselton-Dyer, Fl. Cap. 4(1): 681 [1908]. **Type:** *Burtt Davy 795,* South Africa, Gauteng province, Pretoria [Lecto. PRE. Isolecto. NH]. Chosen here. *Pegler s.n.*, South Africa, North West province, Rustenburg [Isosyn. BOL]; *Burke s.n.*, South Africa, Free State province, Caledon River [Syn. *n.v.*]; *Bolus 8113*, South Africa, Free State province, Bester's Vlei near Witzieshoek [Isosyn. BOL]; *Burke s.n.*, South Africa, Gauteng province, Magaliesberg [Syn. TCD]; *Zeyher 1158*, South Africa, Gauteng province, Magaliesberg [Syn. *n.v.*]; *Nelson 323*, South Africa, Gauteng province, Yster Spruit [Syn. *n.v.*]; *Rehmann 4155*, South Africa, Gauteng province, near Pretoria [Syn. *n.v.*]; *Burtt Davy 673*, South Africa, Gauteng province, near Pretoria [Syn. *n.v.*]; *Burtt Davy 2131*, South Africa, Gauteng province, near Pretoria [Syn. *n.v.*]; *Leendertz 328*, South Africa, Gauteng province, near Pretoria [Syn. *n.v.*]; *Burtt Davy 2045*, South Africa, Mpumalanga province, near Nylstroom [Isosyn. PRE]; *Holub s.n.*, South Africa, Mpumalanga province, Linokana & Matebe Valley [Syn. *n.v.*]; *Gerrard 1291*, South Africa, KwaZulu-Natal province, Zululand [Syn. *n.v.*]; *Burtt Davy 3009*, Swaziland, Bremersdorp [Syn. *n.v.*]; *Burtt Davy 3277*, Swaziland, Bremersdorp [Syn. *n.v.*].

Discussion: Brown (1908) when he first described var. *media* said it ".... is probably a hybrid between *A. gibba* Schlechter, and *A. eminens* Schlechter." Certainly, these two species have distributions and habitats that are largely sympatric (fig. 19 & 26), and herbarium specimens exist where the two parents, plus *B. xmedia*, can be found on the

same sheet (*Dieterlen 365*)*. Many herbarium specimens also show evidence of introgressive hybridization. In fact, *B. xmedia* is to be found wherever *B. gibba* and *B. eminens* occur together, it is thus significant that in the Eastern Cape where only one of the parents, *B. gibba*, is found the hybrid does not occur. There seems to be little doubt that this taxon is very probably of hybrid origin. As its name implies, *B. xmedia* is in every way intermediate between *B. gibba* and *B. eminens* (fig. 24 & 25). To place it as a variety under either of these two species would unfairly ally it closer to one than the other. Also, *B. xmedia* appears to be more tolerant of arid conditions than either of its parents, as a result, it has ventured into drier areas than either parent and thus has a distribution that is unique (fig. 19 & 26). Further, *B. gibba* and *B. eminens* have a shorter flowering period beginning in November (rarely as early as October), while *B. xmedia* may begin flowering as early as July. This temporal difference combined with the lesser ecological and spatial separation could help act as an isolating mechanism. Such reproductive barriers could reduce the frequency of backcrossing, and so help this taxon maintain its own genetic and morphological integrity; which may account for the fact that the taxon is so consistent in it morphology. *B. xmedia* would seem to be an excellent example of speciation in progress through hybridization. All this, plus compliance with Article H, particular H.5.2, of the **International Code for Botanical Nomenclature** (Greuter *et al.*, 1993), has lead us to raise this taxon from varietal rank to that of species, and to supply it with a name that indicates its hybrid origin. Plants flower between July to February, peaking in January, and occur at altitudes of between 1200 to 1400 meters, but occasionally as low as 450 meters. This species is usually found growing in highveld and midland grasslands, occasionally found on river banks and road sides. Usually in dryer areas of KwaZulu-Natal, in the Drakensberg rain shadow and dry continental interior. *B. xmedia* can be distinguished from *B. gibba* mainly in its corona-lobe structure: The upper proximal ends overtop the style-apex (by at least 2mm) rather than level with them and the upper distal appendage is still subulate but much shorter, and the keel is not so gibbous. In these feature it is more like *B. eminens*, from which it is sometimes more difficult to distinguish. However, unlike *B. eminens* the corona-lobes are shorter, less

* It has been suggested that this particular specimen consists of three different collections, but there is no evidence to support this. Other Dieterlen specimens we have seen appear to represent only single gatherings. We see no reason to suspect that this specimen is any different.

sinuous and the upper distal appendage is subulate and pungent rather than broad and dentate. These differences are detailed in table 6.

Table 6. Differences between *B. gibba*, *B. xmedia* and *B. eminens*. All measurements in mm.

Character	***B. gibba***	***B. media***	***B. eminens***
Leaf length	5 to 84	8 to 86	7 to 105
Petiole length	0.3 to 5.0	3.5 to 7.5	1 to 9
Flower height	5 to 15	9 to 19	1 to 27
Petal length	6.5 to 10.3	8.5 to 13.2	10.5 to 20.0
Petal width	2.4 to 4.3	2.8 to 5.0	3.0 to 6.0
Corona-lobe shape	Gibbous but not sinuous	Slightly gibbous but not sinuous	Not gibbous but sinuous
Coronal curtain	N/A	Not constricted above the style-apex	Constricted above the style-apex
Corona-lobe length	4.5 to 8.5	6.8 to 10.0	7.0 to 13.2
Upper distal corona-lobe appendage type	Subulate & pungent (1.2 to 2.8 long)	Subulate & pungent (1.0 to 2.2 long)	Broad & shortly dentate (0.4 to 2.0 long)
Corona-lobe sinus length	3.8 to 5.2	5.3 to 8.0	7. to 13.2
Anther-wing length	1.7 to 2.5	2.2 to 2.8	2.5 to 3.5
Pollinium length	1.11 to 1.72	1.36 to 1.96	1.6 to 2.4

The differences exhibited by *B. xmedia* are distinct and constant despite the fact that this taxon is widely distrubutes and probably of hybrid origin. Illustrated in Nicholas (1981 & 1987).

Distribution: Southern African endemic. Botswana, Lesotho, South Africa [Northern, North-West, Gauteng, Mpumalanga, Free State and KwaZulu-Natal province] and Swaziland (fig. 19).

Conservation Status: Status uncertain. Probably not yet of concern, especially in more arid areas.

Representative Specimens: Botswana: *Tapscott s.n.*, Lobatsi [BOL]. **Lesotho:** *Dieterlen 365*, Likhoele [PRE]; *Compton 21496*, Makhotlong [NBG, PRE]. **South Africa:** Northern: *Leendertz 5618*, Warmbaths [PRE]. North-West: *van Wyk 759*,

Leeuwfontein [PRE]; *Convent 39*, Klerksdorp [GRA]; *Sutton 686*, Boskuil [PRE]; *Kinges 1970*, Lichtenberg district [PRE]; *Leendertz 9504*, Rustenburg [PRE]. Gauteng: *Leendertz 10856*, Vereeniging [PRE]; *Gilfillan 232*, Grootvlei Farm, Heidelberg [PRE]; *Smith 1421*, Lions Bridge, Pretoria [PRE]; *Leendertz 9650*, Pretoria [PRE]; *Renton 373*, Prince's Park, Pretoria [PRE]. Mpumalanga: *Burtt Davy 895*, Standerton [PRE]; *Wasserfall 74*, Excelsior, Korannaberg [BLFU]; *Burtt Davy 5440*, Ermelo [PRE]; *Leendertz 9502*, Bethal [PRE]. Free State: *Potts 3876*, Vereeniging [GRA]; *Pont 549*, Kroonstad [PRE]; *Acocks 11178*, Hobhouse [PRE]; *Tylden s.n.*, Commissie Poort [NBG]; *Potts 3671*, Rivenhill Farm, Ficksburg [BLFU, GRA]; *Goosen 427*, Heilbron [PRE]; *Roberts 2893*, Thaba 'Nchu [PRE]. KwaZulu-Natal: *Beeton s.n.*, Wakkerstroom [SAM 41778]; *Comins 489*, Albert Falls Dam [NU]; *West 522*, Estcourt [PRE]; *Thode 2569*, Altemooi [JF, STE]. **Swaziland:** *Compton 31088*, Mpisi, Manzini [NBG]; *Stewart 9515*, without precise locality [GRA].

4. ***Bruynsia eminens*** (Harv.) Nicholas. *Comb. nov.* **Type:** *Gerrard & McKen 1291*, South Africa, KwaZulu-Natal province, Zululand [Holo. TCD] (fig. 20).

Gomphocarpus eminens Harv., Thes. Cap. 2: 60 & t.195 [1863]. **Type:** As above.

Asclepias eminens (Harv.) Schltr., in Journ. Bot.: 453 [1896]. **Type:** As above.

Stenostelma eminens (Harv.) Bullock, in Kew Bull.: 324 [1953]. **Type:** As above.

Discussion: This is a widely distributed and quite spectacular species with its southern limits in KwaZulu-Natal and norther limits in Zibabwe. The specific epithet *eminens* refers to the extraodinary and very "eminent" corona-lobes, these are, in southern African specimens at least, 7.0 to 14.5mm tall, overtopping the style-apex by as much as 3.5 to 6.6mm. It is also sinuous and the entire corona is constricted just above the level of the style-apex (fig. 17). In Zimbabwe these corona-lobes are shorter (6.5 to 10mm), overtopping the style-apex by only 2 to 5mm and the corona not constricted above the style-apex; in this they approach *B. xmedia*. This shorter nature was also noticed by Brown (1908). The Zimbabwe specimens also seem to have a longer flowering period from October to December, while in South Africa it is from November to January. *B. eminens* is found growing in open grasslands, especially on rocky hillsides and in more or

less arid situations. Plants occur at altitudes of between 600 to 1800 meters. Sotho names include *montsoko* and *montsokoane*. Apparently, in Lesotho all parts of the plant are usually eaten raw, less commonly cooked then eaten. The roots are also crushed then dried, the powder being mixed with boiling cow's milk and then drunk; presumably as a tonic. (Fox & Norwood Young, 1982). Illustrated in Harvey (1863) and anonymous (1926). Illustrated in Nicholas (1981 & 1987).

Distribution: South central African endemic. Lesotho, South Africa [Northern, North-West, Gauteng, Mpumalanga, Free State and KwaZulu-Natal provinces], Swaziland and Zimbabwe.

Conservation Status: Not yet threatened, but vunerable in the long term especially in the KwaZulu-Natal and Gauteng provinces where it is not common.

Representative Specimens: Lesotho: *Archibald 683*, Mount Austin [GRA]; *Dieterlen 365*, Leribe, Likhoele [PRE, SAM]; *Jacot Guillarmod 2139*, Manganeng plateau [PRE]; *Schmitz 313*, near Maseru [PRE]. **South Africa:** Northern: *Breyer 20890*, Louis Trichardt [PRE]; *Rogers 18144*, Louis Trichardt [J]; *Markolter s.n.*, Daviesville [STE 16310]; *Bredenkamp & van Vuuren 358*, Pietersburg Nature Reserve [PRE]. North-West: *van Westhuisenn s.n.*, Dassiesrand, Potchefstroom [PRE]; *Coetzee 495*, Rustenburg [PRE]; *Peeters, Gericke & Burelli 168*, Mooifontein [J, PRE]. Gauteng: *Nicholas 2794 with Baijnath & Singh*, Suikkerbossie Rand Nature Reserve [UDW]; *Nicholas 2703*, Pretoria [PRE]; *Leendertz s.n.*, Pretoria [BLFU 885]; *Fairall 1654*, Waterkloof, Pretoria [NBG]; *Thode A1732*, Pretoria [NH]; *Moss 8494*, Park View, Johannesburg [J]; *Moss 18153*, Parkwood, Johannesburg [J]; *Liebenberg 8444*, Johannesburg [PRE]; *Isaacs 325*, Klipriversberg, Alberton [PRE]; *Clarke 1061*, Moreleta spruit, Lynwood [PRE]; *Rogers 25212*, Primier Mine, Pretoria [GRA]; *HBG (= Gilliland) 24638*, Linbo Park, West Rand [J]; *Behr 175*, Roodepoort [NBG]; *Moss 8492*, Silverton, Pretroia [J]; *van Rooyen 2097*, Roodeplaat Nature Reserve [PRE]; *Pharmacological Laboratory, University of the Witwatersrand s.n.*, Diepkloof [J 34181]. Mpumalanga: *Buthelezi 215*, near Paulpietersburg [NH]; *Thode A2836*, Sondagsfontein [NH]; *Thorncroft 2768*, Barberton [GRA]; *Rudatis 2670*, Wonderhoek, near Middleburg [STE]; *Rogers 22719*, Godwan River [NH]; *Galpin 699*, Barberton [PRE, SAM]; *Germishuizen 5181*, 15kms from

Figure 17. *Bruynsia eminens*: a. Whole plant showing habit; b. Inflorescence; c. Close up of flowers. *Bruynsia sp.*: d. Flowers. *B. navicularis*: e. Inflorescence; f. Close up of flowers from above. Photographs: a & c to f by A. Nicholas; b by van Wyk & Malan.

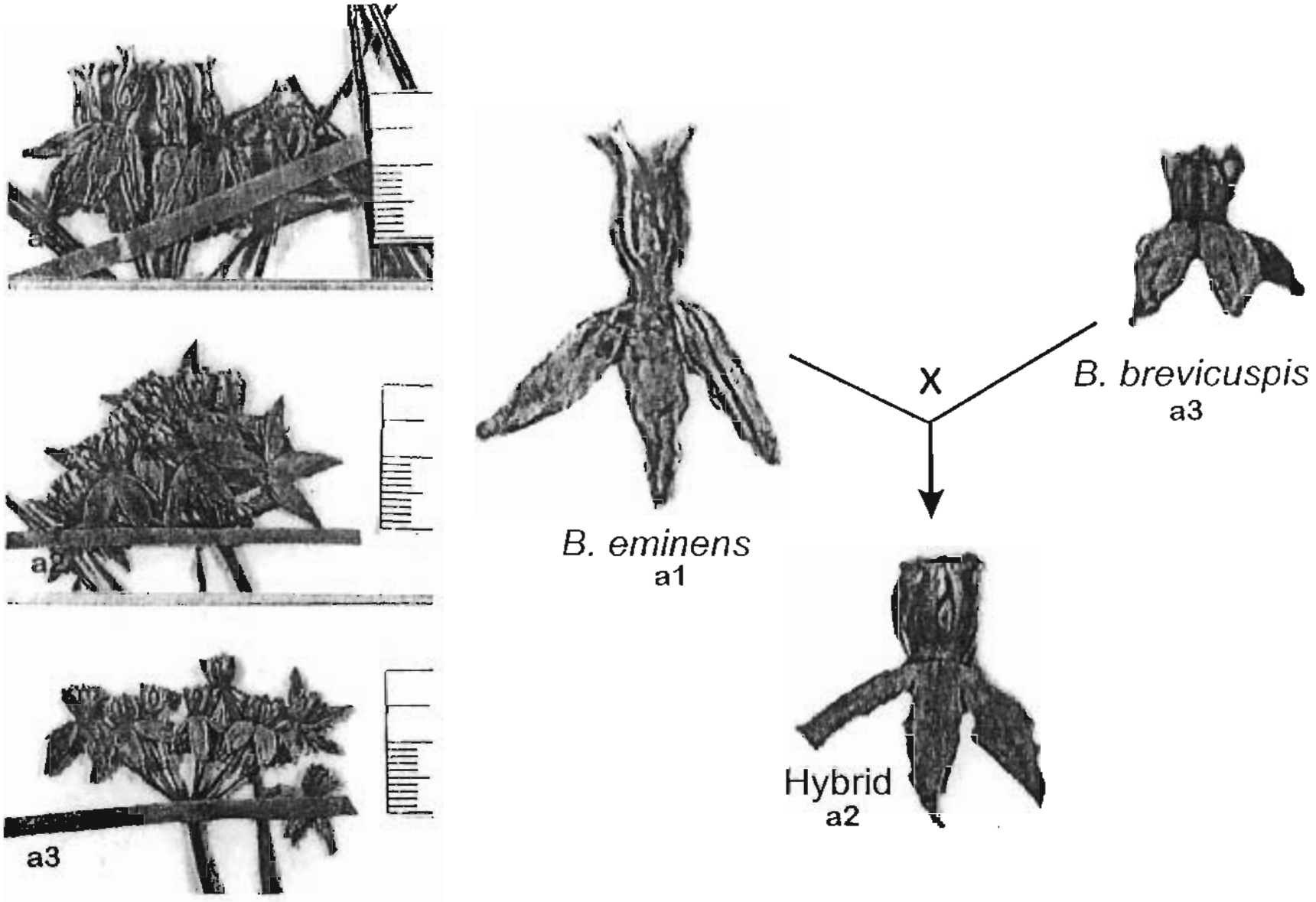


Figure 18. a1. *Bruynsia eminens*; a2. *B. eminens* x *B. brevicuspis*, and; a3. *B. brevicuspis*. All three specimens were found growing in the same field by the senior author.

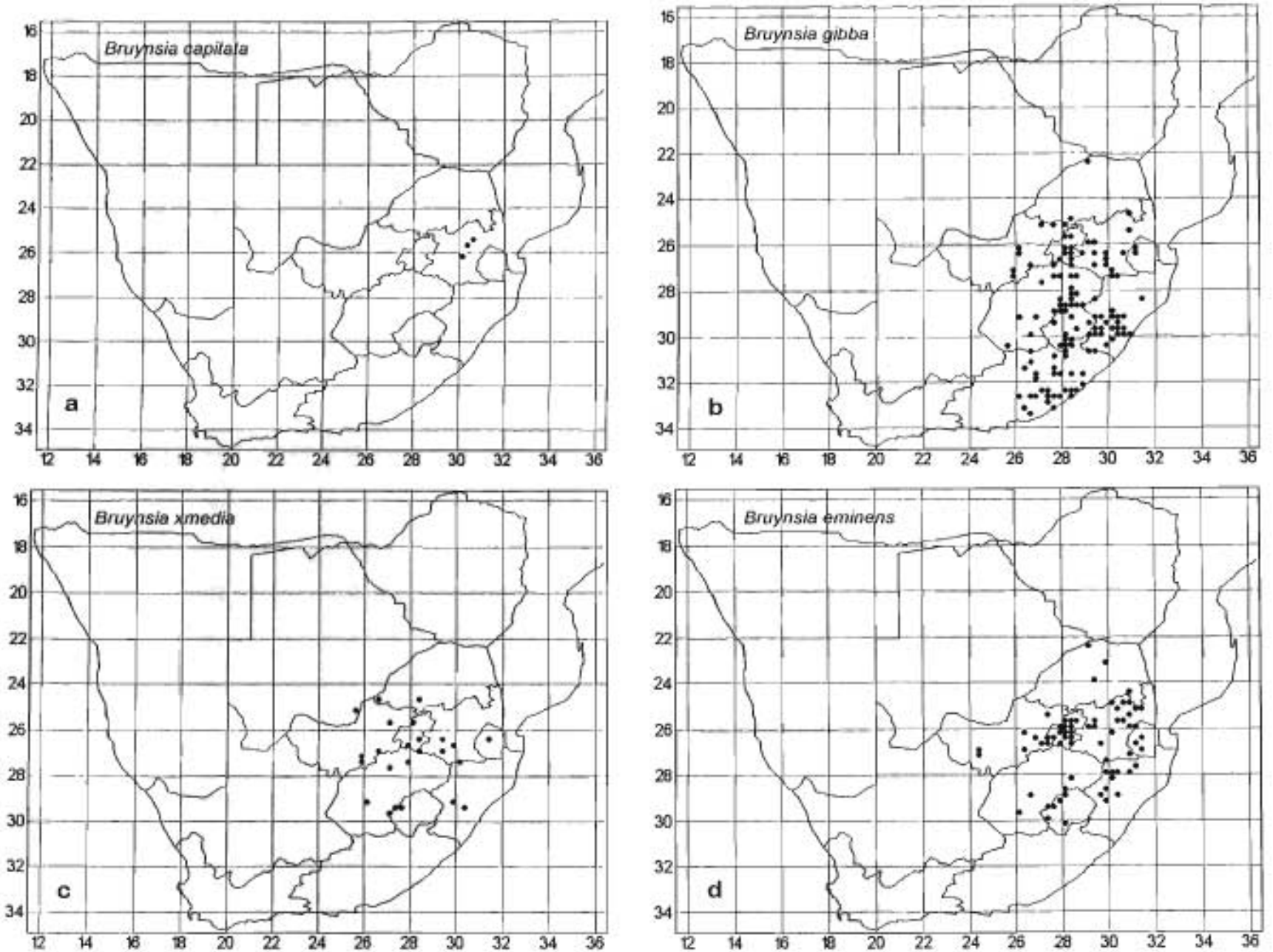


Figure 19. Distribution maps of: a. *Bruynsia capitata*; b. *B. gibba*; c. *B. xmedia* and; d. *B. eminens*.

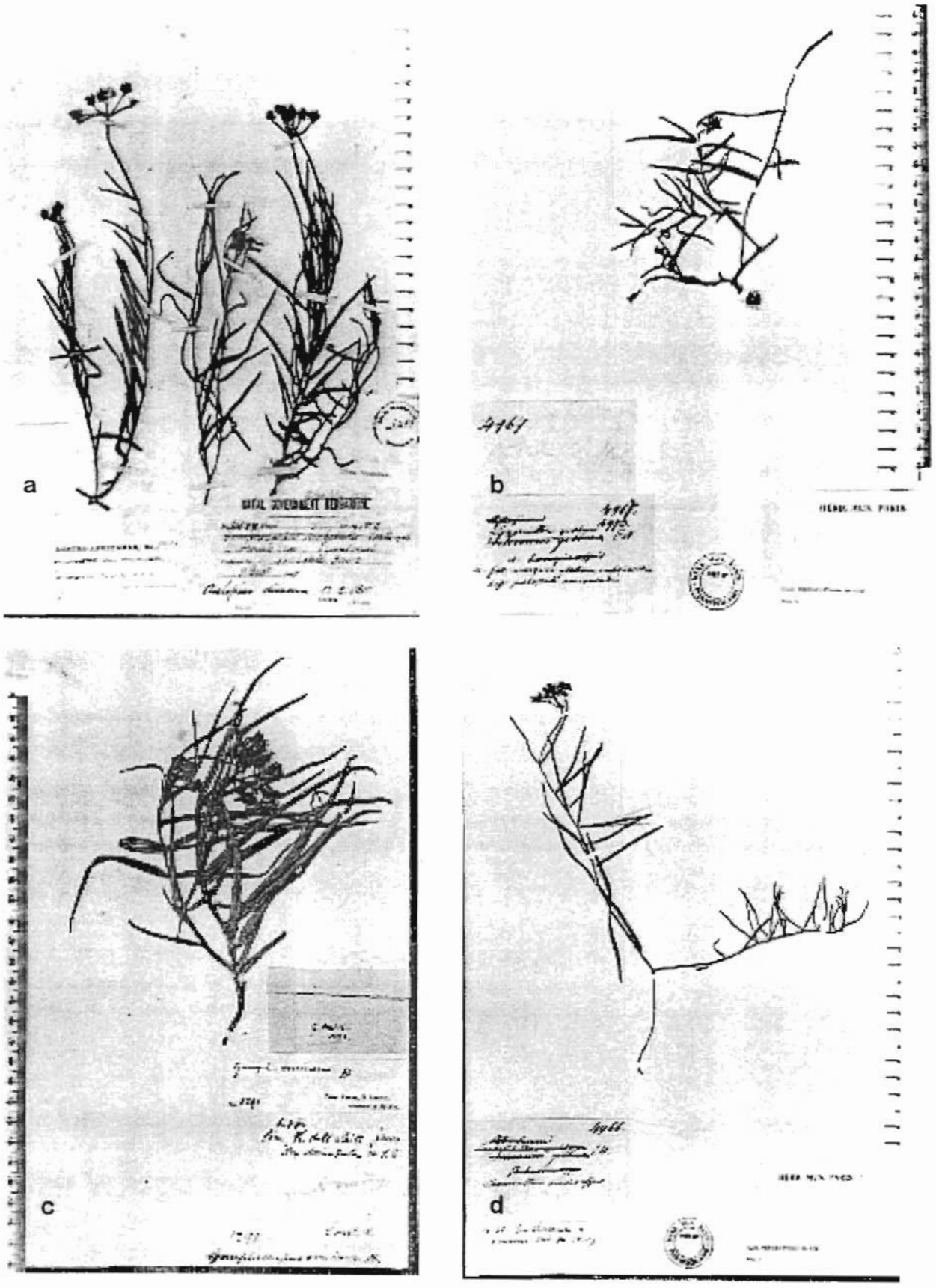


Figure 20. a. Isotype of *Asclepias dissona* [Schlechter 3903 (NH)] a synonym of *Bruynsia capitata;* b. *Bruynsia gibba*, Drege 4967 (P); c. Holotype of *B. eminens*, Gerrard & McKen 1291 (TCD); d. Isotype of *B. brevicuspis*, Drege 4966 (P).

Dullstroom turn off on Lydenburg–Machadodorp road [PRE]; *Germishuizen 5731*, Songiwelo Game Reserve, Kangwane [PRE]. Free State: *Potts 3102*, Dunelm farm, Fouriesburg [BLFU]; *Goossen 427*, Heibron [BLFU]; *Phillips 3112*, Bethlehem [PRE]; *Watkin s.n.*, Fouriesburg [STE]; *Potts 3102*, Dunelm Farm, Fouriesburg [PRE]; *Gemmell s.n.*, Wynford, Fouriesburg [BLFU 6027]; *Gemmell s.n.*, Fouriesburg, Wyndford [BLFU 6027]; *Roux 1079*, near Sterkfontein Dam [PRE]. KwaZulu-Natal: *Nicholas 958*, near Colenso [CPF, NU]; *Nicholas 1746 with van den Berg*, near Tina's Drift, Vryheid [CPF, K, MO, NH, PRE]; *Wood 4692*, Buffalo Valley [GRA, NH, PRE, SAM]; *A & G Hutchings 2641*, Itala Reserve [ZULU]; *Roux 1079*, Sterkfontein Dam [NBG]; *Thode 8395*, Bergveld [JF, STE]; *Ross 21*, Wasbank [NH]; *Williams 107*, Itala Nature Reserve [NH]; *Kok & Pienaar 1274*, near Paulpietersburg [PRE]. Eastern Cape: *Peeters, Gericke & Burelli 168*, Mooifontein [PRE]. **Swaziland:** *Stewart 9515*, without precise locality [GRA]; *Compton 28337*, Mankaiana [NBG, NH, PRE]; *Karsten s.n.*, Malkens [NH 111142]; *Compton 31088*, Mpisi [PRE]. **Zimbabwe:** *Biegel 1444*, Gweru [PRE]; *Barnes 7*, Harare (Salisbury) [RUH]; *Eyels 460*, Mazoe [SAM]; *Young 906*, Harare [J].

5. ***Bruynsia brevicuspis*** (E. Mey.) Nicholas. *Comb. nov.* **Type:** *Drége 4966,* South Africa, KwaZulu-Natal province, between Umzimkulu and Umkomaas rivers [Holo. B† Iso. P] (fig. 20).

Lagarinthus brevicuspis E. Mey., Comm. Pl. Afr. Aust.: 204 [1838]. **Type:** As above.

Gomphocarpus brevicuspis (E. Mey.) Dietr., Syn. Pl. 2: 9 [1840]. **Type:** As above.

Asclepias brevicuspis (E. Mey.) Schltr., in Engl., Bot. Jahrb. 21.(5). Beibl. 54: 5 [1896]. **Type:** As above.

Discussion: This is a species whose exact delimitation has been confused with closely allied species namely *B. navicularis*, *B. gibba* and *B. dissona*. This is not surprising as *B. brevicuspis* differs from these only in floral features, particular in corona structure. In *B. brevicuspis* the corona-lobes are columnar with the upper proximal ends shoulder-like, obtuse and level with the style-apex, the upper margin is more or less truncate, the upper

distal end is short and dentate but like the proximal end it is level with the style-apex, the keel is striaght or with a small medial gibbosity, the sinus is a shallow unobstructed furrow (one of the main characteristics for distinguishing it from *B. navicularis*) (fig. 16). Interestingly, one specimen we have examined (*without collector or number* in NH 878) has a small apical obstruction in the sinus as is found in *B. navicularis*, but this is not usual, the two species differing in flower color, corolla orientation, petal shape with slightly revolute and sinuate margins, and corona-lobe structure. This species is found growing in coastal and midlands areas, basically those areas that are more or less frost free. The distribution of *B. brevicuspis* is more or less sympatric with that of *B. gibba* but the two are different in ecological preference, although some degree of hybridization does occur (fig. 23). Plants occur in various open grasslands, usually in direct sunlight and on black-loamy soils, and are found at altitudes of between 50 to 1500 meters. This species flowers from August to February with one collection in April, but peaking in November. Illustrated in Nicholas (1981 & 1987).

Distribution: South African endemic [Mpumalanga, Kwazulu-Natal and Eastern Cape provinces] (fig. 21).

Conservation Status: Not threatened at this time, but certainly so in the long term.

Representative Specimens: South Africa: Mpumalanga: *Pott 4902*, Spitzkop, Ermelo [PRE]; *Jenkins 10912*, Piet Retief [GRA]. KwaZulu-Natal: *Nicholas 952*, between Estcourt & Colenso [CPF, K, MO, NH, NU]; *Nicholas 1745 with van den Berg*, nea Tin's Drift, Vryheid [CPF, K, NH, MO]; *Ngwenya 211*, near Umtamvuna [NH]; *Sanderson 149*, near Port Natal [TCD]; *Plant 54*, near Port Natal [TCD]; *Lawn 1201*, Gingindhlovu [NH]; *Moss 19236*, Port Edward [J]; *Mogg 5782*, Amatikulu [PRE, SAM]; *Thode 2574*, Emangweni [JF, STE]; *Moll 2468*, Groutville, Lower Tugela [NU, PRE]; *Ward 2422*, Hluhluwe Game Reserve [NH, NU]; *Munday 506*, Hluhluwe [J]; *Thode 2573*, Chakaskraal [STE]; *MacDonald 572*, Cwaka Agricultural College, near Empangeni [NH]; *Pienaar 584*, Port Shepstone [PRE]; *Acocks 9962*, Estcourt P.R. Station [NH, PRE]; *Schrire 2291*, near Izotcha, Port Shepstone [NH]. Eastern Cape: *Venter & Vorster 176*, Mzintlava River Mouth [PRE]; *Galpin 11451*, Port St. Johns [PRE]; *Mogg 13058a*, Ndhluzulu Head [PRE].

6. ***Bruynsia species***

Discussion: This unamed species is only known to us from three specimens, all rcently collected in the 1980s. Although it has corona-lobes similar to *B. gibba* it differs from this and other species in this genus by having flowers much smaller; about half the size. It also differs in a number of other floral features. Because this species is so anomalous within the genus *Bruynsia* (to which it clearly belongs) and is only known from so few specimens we plan to name it at some later stage (fig. 17). It may possibly turn out to be of hybrid origin between *Bruynsia gibba* and *Schizoglossum sensu lato* but there is no positive confirmation of this.

Distribution: South African endemic [Kwazulu-Natal province only] (fig. 21).

Conservation Status: Vulnerable. Extremely rare and occuring in an area that is heavily farmed this undescribed species must be considered threatened.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 953*, between Estcourt & Colenso [NH]; *Green 207*, Estcourt [NH]; *Manning 640*, Biggarsberg, Boschoek military area [PRE].

BRUYNSIA **Nicholas Section** ***CRYPTOGLOSSA*** Nicholas, *sect. nov.* ***Caulis*** *105—290mm longus.* ***Flores*** *6—14mm longi, 7—18mm lati.* ***Corolla*** *lanceolato, aliquando angusto ovato, erecto-patens, margine lobi leviter revoluto et sinuato.* ***Coronae lobi*** *sine appendicis superioribus, apicalis obtegens (B. navicularis et B. disparilis) vel cum lateralis compressis linguiformis appendis (B. compressidens).* ***Gynoecii*** *apex applanatus vel laeve conicus.* **TYPUS:** *Bruynsia navicularis* (E. Mey.) Nicholas, *vide infra.*

Description: *Stems* 1–6 per plant, 105—290mm long. *Leaves*: Lamina linear to lanceolate, occasionally narrowly lanceolate, narrowly ovate or falcate, (5-)8—85mm long, 1—5mm wide, apex sharply acute; petioles 1.5—5.0mm long. *Inflorescences* 1—7 per plant, 4—8(-10)-flowered; peduncles 9—35mm long; bracts linear-triangular to linear, 3.8—7.7mm, 0.24—0.9mm wide. *Flowers* lilac or pink to light gray, 6—14mm tall, 7—18mm wide, spreading-rotate; pedicels 0.9—2.1mm long. *Sepals* lanceolate,

occasionally triangular, 3.5—7.0mm long, 1.2—2.0mm wide. *Petals* spreading with tips erect, lanceolate, narrowly ovate to ovate, 8.2—12.0mm long, 3.2—5.0mm wide. *Corona-lobes* 3.8—5.2mm tall, 1—2mm wide, upper proximal ends obtusely rounded, shoulder–like occasionally folded inwards, lower than or level with the style-apex, upper distal end blunt or raised slightly, level with or lower than the style-apex, upper margin truncate or concavely sloping downwards, outer keel rounded or straight, inner margin shallowly concave or vertical, sinus a narrow central channel with an inner apical transverse flap or hood of tissue (*B. navicularis* and *B. disparilis*), or a laterally compressed, tongue-like appendage (*B. compressidens*). *Staminal-column* 3—4mm tall; anther–wings (1.1-)1.4—1.8mm long, 0.4—0.7mm wide; anther–appendages triangular to ovate, 0.7—1.3mm long, 0.9—1.4(-1.6)mm wide. *Style-apex* truncate to slightly conical, 1.9—3.0mm in diameter with a centeral depressed pit. *Fruit:* ±85mm long, ±6.5mm wide. *Style-apex* truncated to slightly conical. *Etymology*: The name *Cryptoglossa* is Greek in origin from *Crypto* (= hidden) and *glossa* (= tongue). It refers to the appendages hidden or covering the corona-lobe sinus.

Discussion: Section *Cryptoglossa* is characterized by having an obstruction of some sort in the corona-lobe sinus. In the case of *B. navicularis* and *B. disparilis* this is a transverse plate or hood of tissue at the top of the sinus, while in *B. compressidens* it is a laterally compressed tongue-like sinus appendage. These structures are probably homologous as a few specimens exhibit a condition between the two states. No such obstructions or appendages are found in the sinus of section *Bruynsia*. Also, going by other charactersitics, especially flower structure, the three species in section *Cryptoglossa* are clearly related. Vegetatively, however, and in in florescence type and general floral gestalt the two sections are very similar.

Distribution: Unlike section *Bruynsia*, section *Cryptoglossa* is not as widespread, being predominantly found in the Eastern Cape province with only a few isolated populations of *B. navicularis* and *B. disparilis* found in KwaZulu-Natal where it boarders the Eastern Cape.

Key To Species

1a. Corona-lobe sinus without a transverse flap or hood of tissue near the apex, with a laterally compressed tongue-like appendage ..... B. *compressidens*

1b. Corona-lobe sinus with a transverse flap or hood of tissue near the apex, without a laterally compressed tongue-like appendage 2

2a. Leaves 1—5mm wide, 5—85mm long. Peduncles 9—30mm long. Upper distal corona-lobe margin flush with the upper proximal margin ..... *B. navicularis*

2b. Leaves 3—9mm wide, 12.5—37mm long. Peduncles 25—75mm long. Upper distal corona-lobe margin slightly protruding above the upper proximal margin ..... *B. disparilis*

7. ***Bruynsia navicularis*** (E. Mey.) Nicholas. *Comb. nov.* **Type:** *Drége 4968,* South Africa, Eastern Cape province, between Chalumna and Buffalo Rivers [Lecto. P] (fig. 22). Chosen here.

Lagarinthus navicularis E. Mey., Comm. Pl. Afr. Austr.: 204 [1838] *pro parte.* **Type:** As above.

Gomphocarpus navicularis (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias navicularis (E. Mey.) Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 8 [1896]. **Type:** As above.

Discussion: The corona-lobes of this species are columnar with the upper proximal margins shoulder-like, obtuse and level with the style-apex, the upper margin is more or less truncate, the upper distal margin is obtuse and level with the style-apex, the outer keel is straight or occasionally sinuous (but without a gibbosity), the corona-lobe sinus is blocked apically with a transverse flap of tissue. An insect with its leg in the sinus would not be able to pull it up and out because the apex is blocked. As a result, to get its leg out it would have to pull it down so positioning it at the basal opening of the gynostegial-groove; ready for pollinarium removal. The corona superficially resembles that of

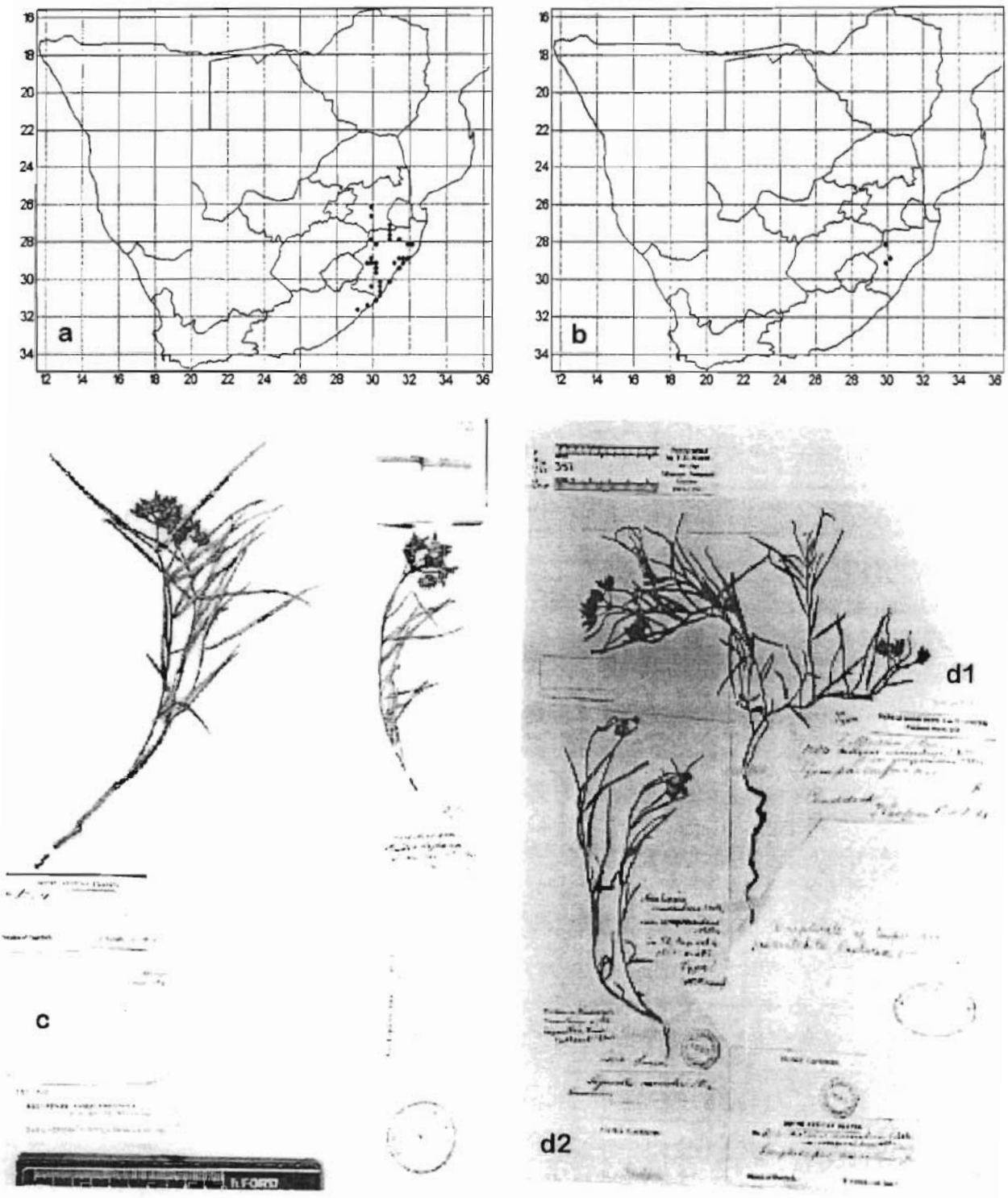


Figure 21. a. Distribution of *Bruynsia brevicuspis*; b. Distribution of *Bruynsia sp.*;c. Isosyntype of *B. compressidens*, D'Urban 71 (TCD); and d1. Lectotype of *B. compressidens*, Cooper 1284 (K); d2. Syntype of *B. compressidens* [*Asclepias navicularis* var. *compressidens*]. Photograph c. by Kew Photographer.

B. brevicuspis; the differences are discussed under this species. They are also similar to *B. compressidens* but in this species (like *B. disparilis*) the upper proximal appendages are much lower than the style-apex and their is no apical obtruction at the top of the sinus but a tongue-like laterally compressed appendage instead. *B. disparilis* is similar in having the apical part of the sinus blocked with a flap of tissue but the corona-lobe is quite different; see discussion under that species (fig. 17). Although *B. navicularis* is sympatric with *B. gibba* and hybrids do occur (see later) they are not common. Hybridization also occurs between this species and the partly sympatric *B. compressidens*. The Paris (P) specimen was seen and annotated by E. Meyer, hence its selection as the lectotype. *B navicularis* is found growing in open grasslands on sandy soils, usually flowering after burning when the grass is still short. Plants usually flower between November and February, rarely later or earlier, and occuring at altitudes of 20 to 900 meters. At sunset this species produces a pleasant, if somewhat heady, scent. Illustrated in Nicholas (1981 & 1987).

Distribution: South African endemic [Eastern Cape province only] (fig. 22).

Conservation Status: Low Risk (Least Concern). Vunerable in the short term, threatened in the long term.

Representative Specimens: South Africa: Eastern Cape: *Nicholas 904b*, Shelley Beach [NU]; *Victor & Hoare 475*, Happy Valley farm, near Hogsback [PRE]; *Wood 1995*, East London [BOL, GRA, PRE]; *Bowker s.n.*, Kreilis country [TCD]; *Dold 893*, Grahamstown [GRA]; *Martin 8862*, near Lombard's Post [RUH]; *Tyson 2945*, King William's Town [NBG, PRE]; *Comins 1355*, near East London [GRA, PRE]; *Sim 1294*, King William's Town [BOL, GRA, SAM]; *D' Urban 71*, King Williams Town [TCD]; *Wood 3378*, East London [GRA, K, PRE]; *Thode 6578*, East London [JF, STE]; *Compton 17802*, Kidds Beach [NBG]; *Giffen s.n.*, Kidds Beach [UFH]; *Dyer 4536*, between East London & Peddie [PRE]; *Bayliss 4629*, Southwell [PRE - with color transparency].

8. *Bruynsia compressidens* (N.E. Br.) Nicholas. *Comb. nov.* **Type:** *Cooper 1284,* South Africa, Eastern Cape Province, Cradock [Lecto. K; Isolecto. TCD, PRE] (fig. 21). *Drége*

s.n. (I, a), South Africa, Eastern Cape province, between Windvogelberg & Zwartkey, in grassland, alt. 3000–4000ft (= 914–1392m) [Syn. K] (fig. 21).

Asclepias navicularis (E. Mey.) Schltr., var. *compressidens* N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 683 [1908]. **Types:** As above.

Asclepias compressidens (N.E. Br.) Nicholas, in Bothalia 17(1): 19—23 [1987]. **Types:** As above.

Lagarinthus navicularis E. Mey., Comm. Pl. Afr. Austr.: 204 [1838] *pro parte.* **Type:** *Drége s.n. (I, a),* South Africa, Eastern Cape province, between Windvogelberg & Zwartkey, in grassland, alt. 3000–4000ft (= 914–1392m) [Syn. K].

Discussion: The corona-lobe shape is unique with the upper proximal ends being shoulder-like, obtuse and about level with the middle of the anther-wings, the upper margin is shallowly concave and slopes up to the obtuse upper distal end which is level with the style-apex, the keel is rounded and the shallow sinus possesses a tongue-like appendage. This species is closely related to *B. navicularis*, the differences are outlined in (Nicholas, 1987), however, a case could be made for considering this an inland variety or subspecies of *B. navicularis*. It also occurs more in land than *B. navicularis* (which is prodominently coastal) being found as far north as Craddock, Queenstown and the Windvogel mountains. The isotype of Drège collected between the Windvogel mountains and Zwartkei river is also the isotype of *B. navicularis*. *B. compressidens* can be found in grasslands occuring in sparsely wooded thornveld. Flowering occurs between November and February, and plants are found at altitudes of between 30 to 140 meters. Illustrated in Nicholas (1981 & 1987).

Distribution: South African endemic [Eastern Cape province only] (fig. 22).

Conservation Status: Vunerable. Threatened by extensive dairy farming and a large sympatric human population.

Representative Specimens: South Africa: Eastern Cape: *Wood 1995*, near East London [K]; *Bayliss 4631*, Southwell [PRE]; *Acocks 17872*, near Alexandria [PRE]; *Acocks 17939*, Queenstown [PRE].

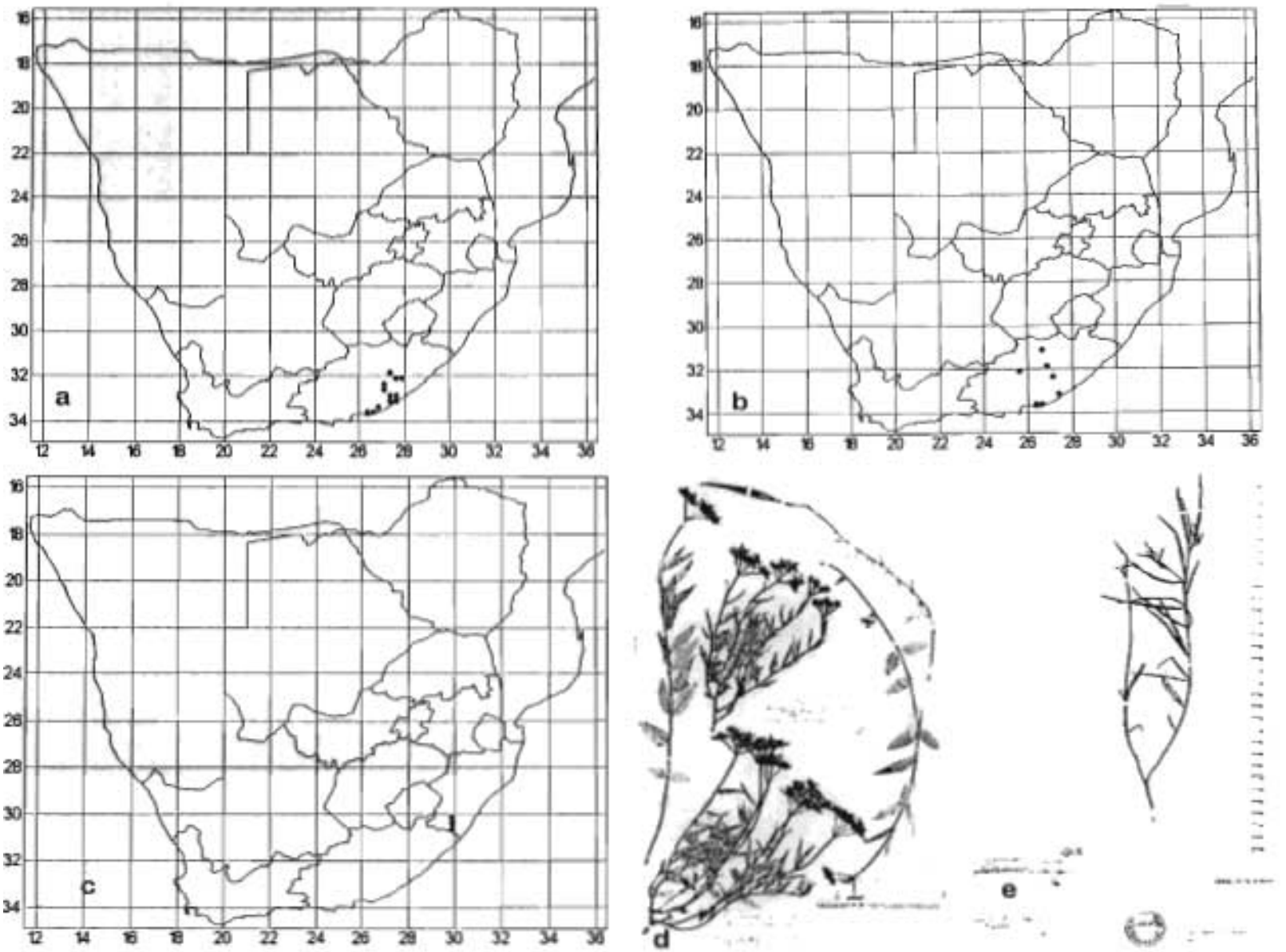


Figure 22. Distribution of: a. *Bruynsia navicularis*; b. *B. compressidens* and; c. *B. disparilis*. d. Lectotype of *B. disparilis*, Tyson 2004 (SAM) and; e. Lectotype of *B. navicularis*, Drege 4968 (P).

9. ***Bruynsia disparilis*** (N.E. Br.) Nicholas *comb. nov.* **Type:** *Tyson 2004,* South Africa, Eastern Cape province, Clydesdale [Lecto. SAM, chosen here. Isolecto. BOL, K] (fig. 22). Chosen here. *MacOwan & Bolus ex Herb. Norm. Austr.-Afr., 1319*, South Africa, Eastern Cape province, Clydesdale [Syn. BOL].

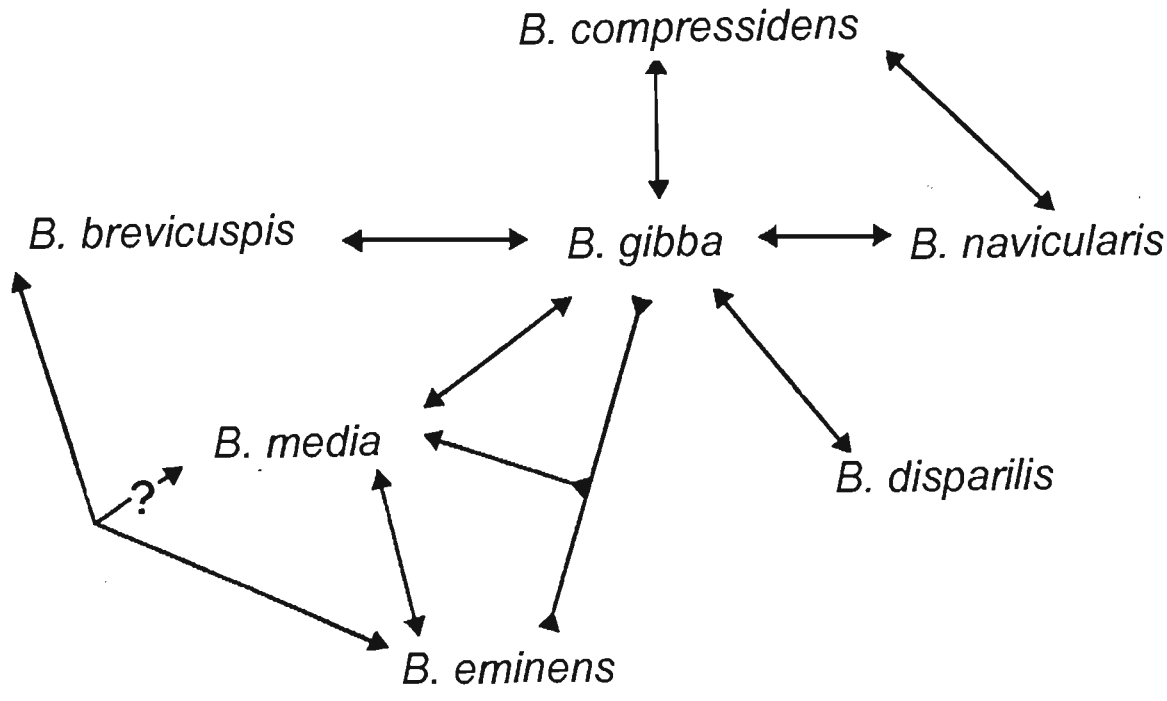
Asclepias disparilis N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 680 [1908]. **Type:** As above.

Discussion: *B. disparilis* differs from other species in the genus in its sometimes (but not always) broad leaves (as much as 9mm in width). The corona-lobe is similar to *B. compressiden* in that the upper proximal ends are lower than the style-apex and the upper distal end is slightly produced (but never overtopping the style-apex), they are also broader (2.2mm versus 1.5 to 2mm) and, like *B. navicularis*, the corona sinus has no appendage but is blocked apically by a horizontal plate of tissue (although sometimes this maybe somewhat reduced and almost tongue-like). To a degree *B. disparilis* intergrades with *B. navicularis* (e.g. *Dold 2918 with Cloete & White*) and, as for *B. compressidens*, a case could be made for treating it as a variety or subspecies under *B. navicularis*. N.E. Brown (1908) has seen and annotated specimens of *Tyson 2004* housed at Kew (K), South African Museum (SAM) and Bolus (BOL) herbariums. Because the Kew collections are well curated, easily accessible and has been a center of Asclepiadaceae research since before the turn of the century, we have tended to select the specimen at Kew, if it exists, as the holotype. However, in this instance the Kew specimen is no more than a small, single branch. The SAM specimen, on the other hand, is generous with material and even includes fruit. We have, as a result, selected this as the holotype. *B. disparilis* occurs in open grasslands and flowers between October to January, or even as late as March. It is found at altitudes of between 750 to 1000 meters.

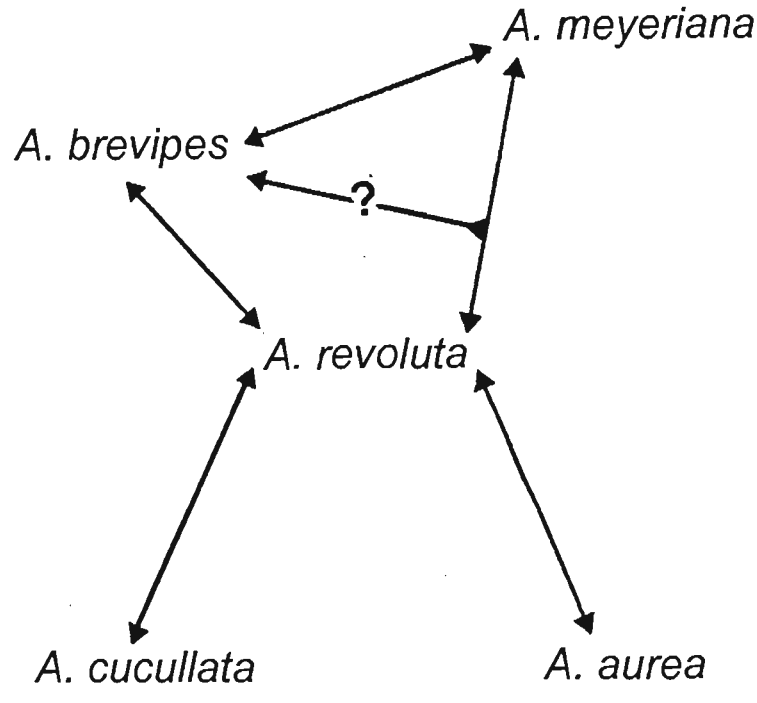
Distribution: South African endemic [Eastern Cape & Kwazulu-Natal provinces] (fig. 22).

Conservation Status: Vulnerable following Scott-Shaw (1999). This occurs in one of the most heavily utilized regions of the eastern midland. The type locality in paticular is heavily degraded and plant is probably extinct here.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 2784 with DC Nicholas*, Harding [UDW]; *Oliver 13*, Harding [NH]; *Hilliard & Burtt 16705*, Bedford &

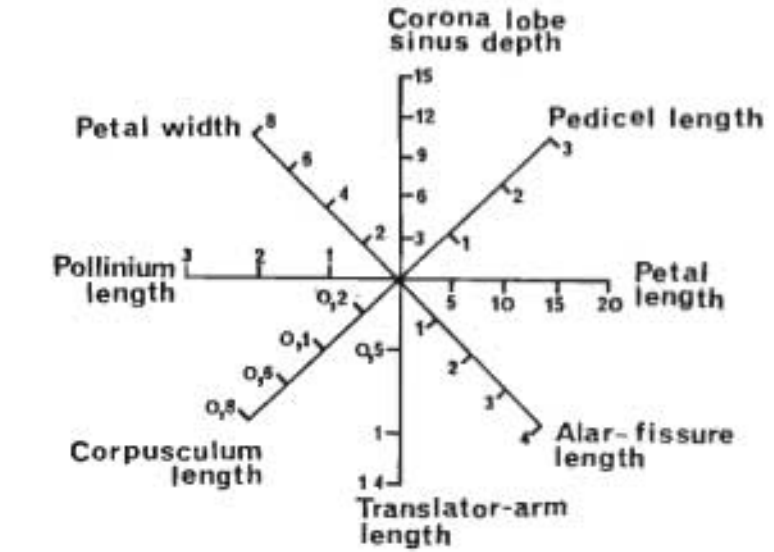


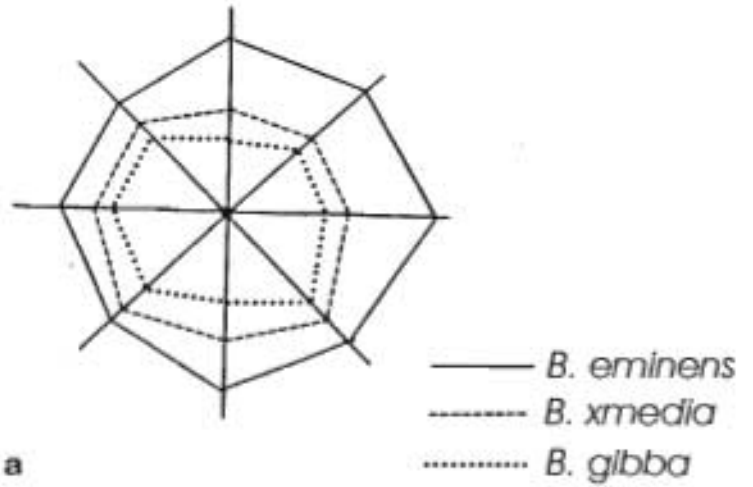
a



b

Figure 23. Putative hybridization patterns in: a. *Bruynsia* and; b. *Aidomene*.





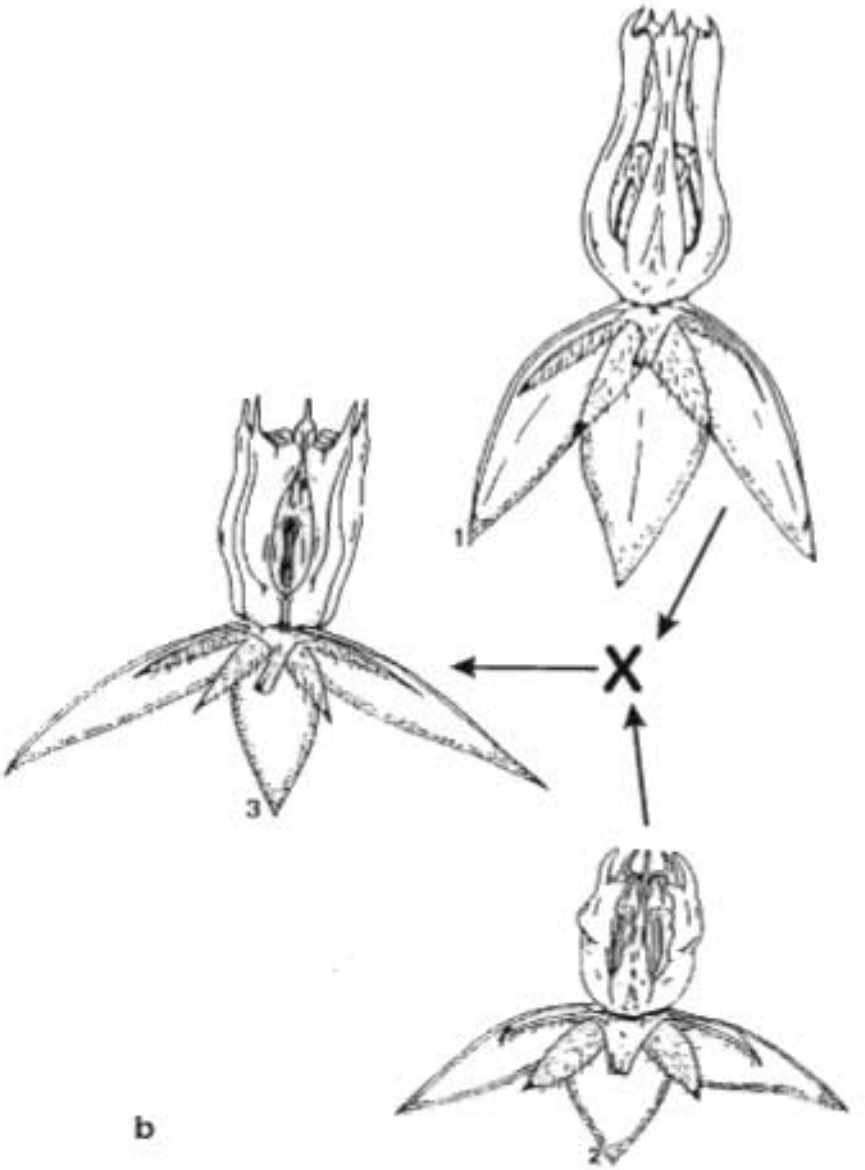


Figure 24. a. Polygonal graph of *Bruynsia eminens*, *B. gibba* and *B.xmedia* showing the latter taxon's intermediate morphology and b. A comparison

Rooivaal farms [NU. PRE, duplicates at E & K not seen]; *Abbott 6831*, Umtamvuna river [NH]; *Acocks 12243*, Harding [PRE]; *Lennox s.n.*, Bedford [NU 32816]; *Taylor 5271*, Rooi Vaal [NBG]. Eastern Cape: *Dold 2918 with Cloete & White*, Horeshoe, near Umzimhlaba bridge [GRA]; *Acocks 13236*, Creighton [PRE]; *Tyson 1319*, Clydesdale [SAM]; *Tyson 1319*, without precise locality.[PRE].

Apparent Hybridization Within The Genus Bruynsia

Based on the assessment of over 400 herbarium specimens and field observations there can be little doubt that hybrization is a common ocurrence in this genus. Seven of the eigth taxa in this genus appear to be involved (fig. 23), only *B. dissona* appears to be exempt. This phenomenon has been partially discussed under the species outlined above, in particular, the hybrid origin of *B. xmedia* is dealt with under that species. The phenomenon was also mentioned by Brown (1908) in his treatment of *Asclepias*. As a result of the large number of intermediate specimens exsisting in herbaria *Bruynsia* has proved to be taxonomically difficult, especially for those workers doing routine identification. Interestingly, hybrid specimens have not been found between the genus *Bruynsia* and other genera of the Asclepiadinae. The phenomenon appears to be intra-generic and not extra generic and so lends further support to erecting a separate genus for this group of species.

B. eminens* X *B. xmedia

There are a handful of herbarium specimens that appear to represent introgressive hyrbidization between *B. xmedia* and one of it putive parents, *B. eminens*. In these specimens the corona-lobes are not quite turret-like as in *B. eminens* but too long (especially the distance between the upper proximal ends and style-apex) to be *B. xmedia* (fig 25). All the apparent hybrid specimens are sympatric with the private parent taxa.

Specimens: South Africa — Mpumalanga: *Pott 3982*, Standerton [SAM]; *Burtt Davy 2045*, near Nylstroom [PRE]; *Without collector, number or locality* [TCD]. N.E. Brown

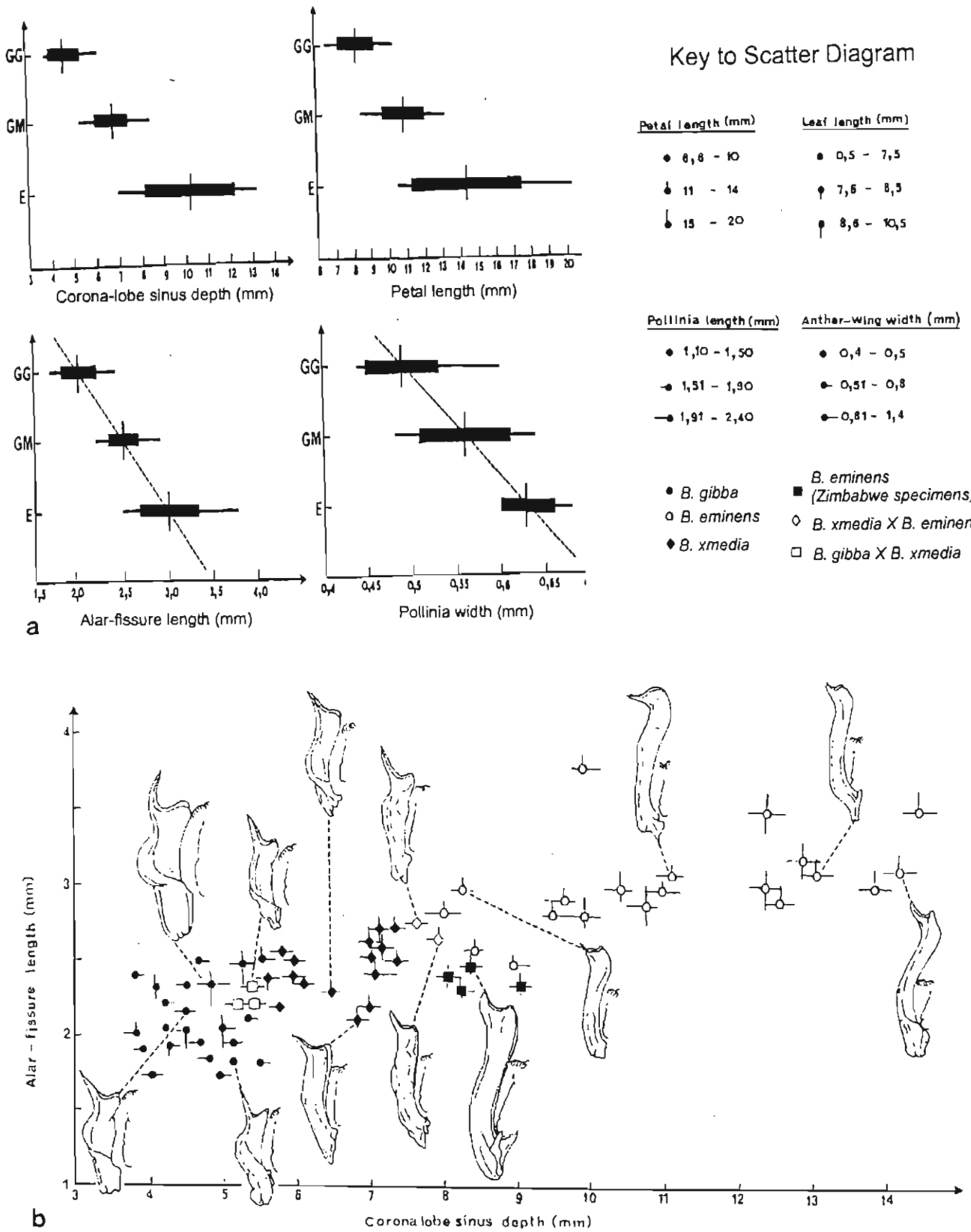


Figure 25. a. Bar graph comparison of *Bruynsia eminens* (E), *B. xmedia* (GM) note this taxon's intermediate morphology & *B. gibba* (GG) and; b. Scatter diagram illustrating the intermediate nature of *B. xmedia* between *B. gibba* and *B. eminens*. Introgressive hybrids and Zimbabwean specimens of *B. eminens* are shown for comparison.

saw this latter specimen and, from the rubbing out, also seemed confused as to its proper identity.

B. gibba* X *B. xmedia

As for *B. eminens* X *B. xmedia* there are a handful of herbarium specimens that appear to represent introgressive hyrbidization between *B. xmedia* and its other putive parent, *B. gibba*. In these specimens the upper proximal corona-lobe ends are almost level with the style-apex, never exceeding it by more than 1mm. The distal corona-lobe appendage is a subulate point never less than 1.4mm long, while the outer keel may or may not have a distinct gibbosity (fig. 25).

Specimens: South Africa — Gauteng: *Mogg 11359*, Onderspoort, Peroria [SAM]; *Mogg 44737*, Onderspoort, Pretoria [SAM]; *Gilfillan 225*, Grootvlei Farm, Hiedelberg [PRE]; *Burke s.n.*, Magaliesberg [BOL]. **Free State:** *Bolus 8113*, Bester's Vlei, near Witzieshoek [BOL]; *Roberts 2465*, Thaba Nchu [PRE]. **Without Precise Locality:** *Bolus 417772* [SAM].

B. gibba* X *B. brevicuspis

Two specimens examined exhibited characteristics more or less intermediate between *B. gibba* and *B. brevicuspis*. In these specimens the outer keel is only slightly gibbous while the upper distal subulate appendage is reduced in length. These specimens are sympatric with the two putative parent species (fig. 27).

Specimens: South Africa — KwaZulu-Natal: *Mogg 11013*, near Durban [PRE]; *Maurice & Evans 523A*, Weenen country [NH].

B. eminens* X *B. brevicuspis

We have only encountered one specimen that is intermediate between *B. eminens* and *B. brevicuspis*. This hybrid was found growing in the same field as the two parent species and resembles *B. xmedia* in apperance, but of a quite different origin (fig. 18).

Specimens: South Africa — KwaZulu-Natal: *Nicholas 1744 with van den Berg*, Tina's Drift near Vryheid [NH].

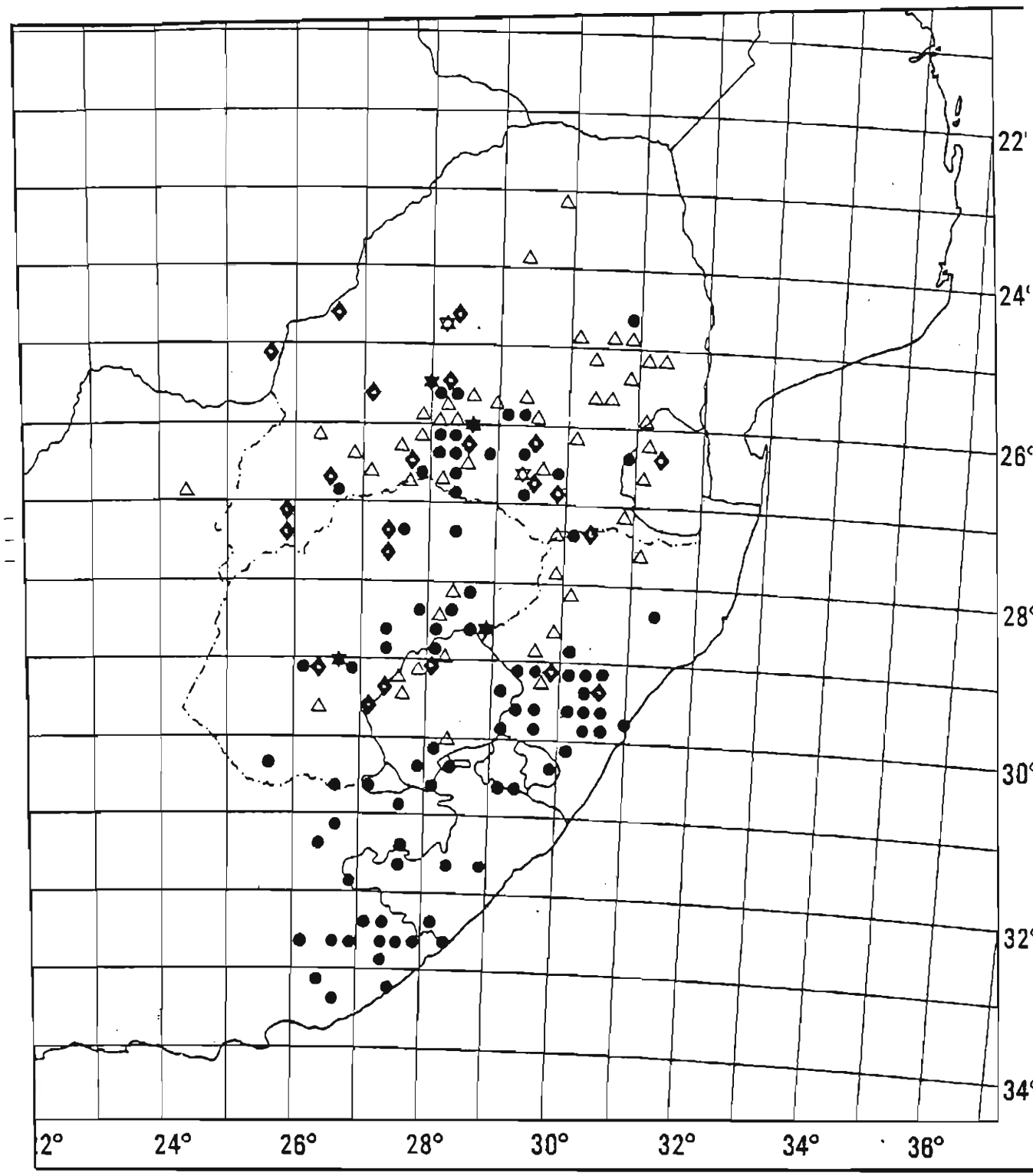


Figure 26. Map comparing the distribution of: *Bruynsia eminens* (▲), *B. gibba* (●), and the hybrid taxon *B. xmedia* (◊). Specimens showing introgressive hybridization between *B. gibba* & *B. xmedia* (★) and B. xmedia & *B. eminens* (☆) are also plotted.

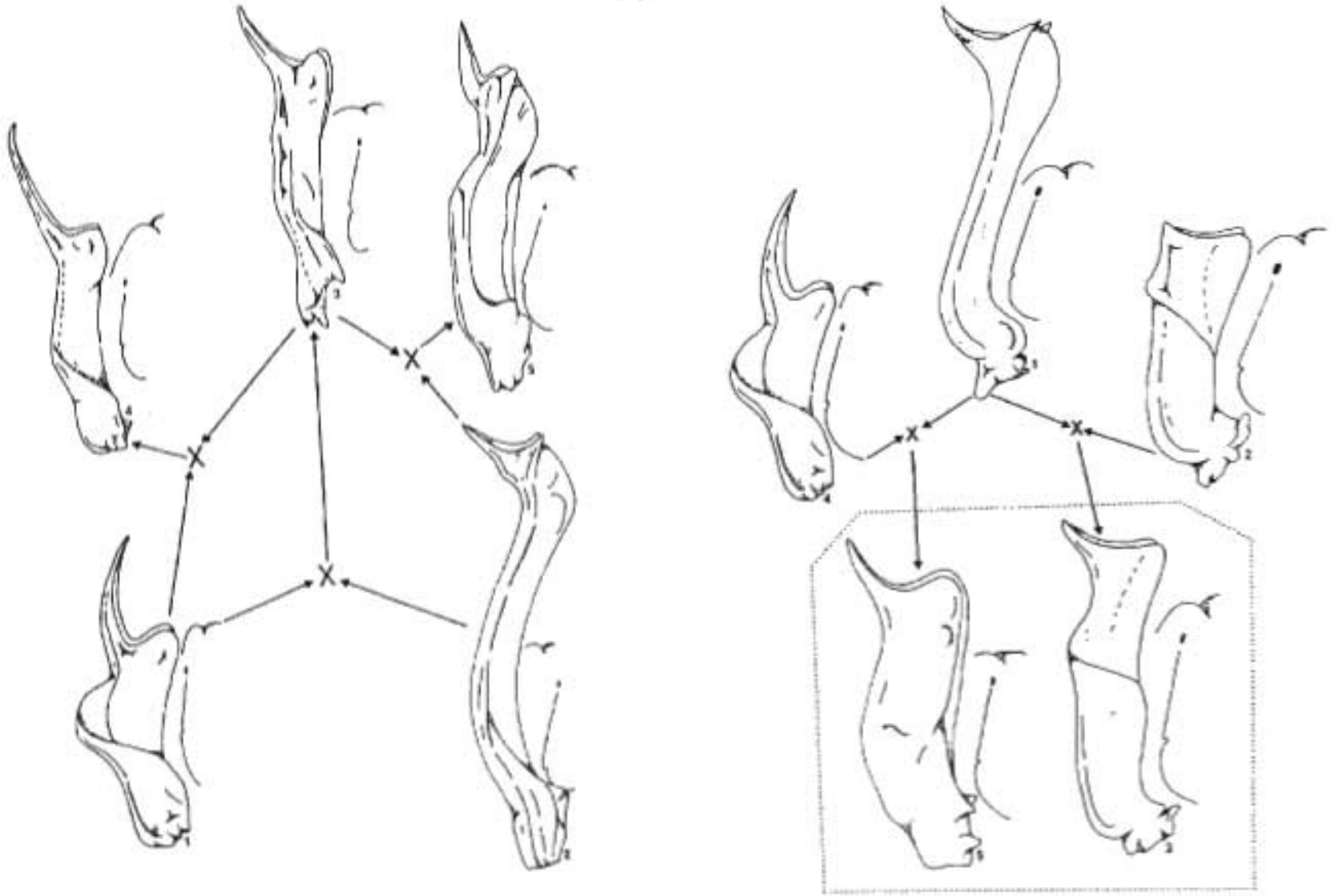


Figure 27. a. A comparison of the corona-lobe structure in 1. *Bruynsia gibba* x8 (Strey 3936 PRE), 2. B eminens x5 (Coetzee 495 PRE), 3. the hybrid taxon *B. xmedia* x6 (Compton 22527 NBG) and introgressive hybrids between 4. *B. gibba* & *B. xmedia* x7 (Mogg 11359 SAM) and 5. *B. xmedia* & *B. eminens* x5 (Burrt Davy 2045 PRE). b. A comparison of the corona-lobe structure of: 1. *B. eminens* x5 (Coetzee 495 PRE), 2. *B. brevicuspis* x9 (Nicholas 1745 NH) and 3. a hybrid specimen produced by these two parent species x7 (Nicholas 1744 NH). Also a comparison of the corona-lobes structure of: 1. *B. eminens* x5 (Coetzee 495 PRE), 4. *B. gibba* x8 (Strey 3936 PRE) and 5. The hybrid taxon *B. xmedia* x4 (Acocks 11178 PRE). Note the similarity of the two circled hybrid corona-lobes. Drawings by A. Nicholas.

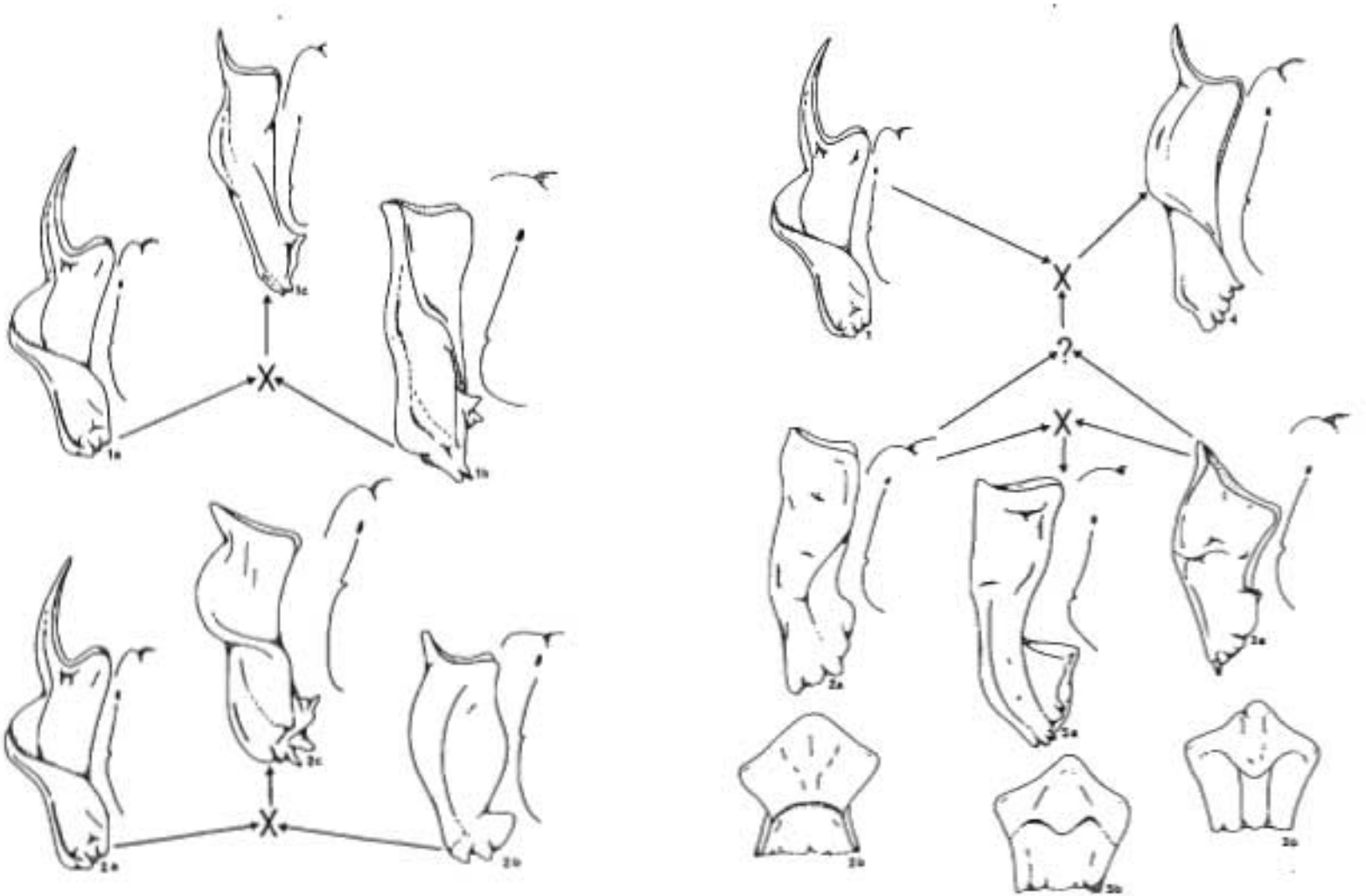


Figure 28. a. A comparison of the corona-lobe structure of two different pairs of hybridizing species: 1a. *B. gibba* x8 (Strey 3936 PRE), 1b. *B. brevicuspis* x11 (Wood 286 SAM) and 1c. Hybrid specimen produced by these two parent species x7 (Evans 5239 NH). 2a *B. gibba* x8 (Strey 3936 PRE), 2b. *B. disparilis* x5 (Hilliard & Burtt 16705) and 2c. The resulting hybrid produced by these two parent species x10 (Tyson 2151 BOL). b. A comparison of the corona-lobe structure of two pairs of hybridizing species: 1. *B. gibba* x8 (Strey 3936), 2. *B. navicularis* a. corona-lobe side view x10 (Comins 1355 PRE), b. inside of corona-lobe sinus showing transverse shelf of tissue x9 (Bayliss 4629 PRE), 3. *B. compressidens* a. corona-lobe side view x9 (Rogers 1276a BOL), b. inside of the corona-lobe sinus showing tongue-like flap of tissue x12 (Acocks 17936 PRE) and 5. Specimen of hybrid origin a. corona-lobe side view, b. inside of corona-lobe sinus showing tongue-like flap of tissue x7 (Acocks 20236 PRE). Drawing by A. Nicholas.

B. gibba* X *B. navicularis or B. compressidens

A number of specimens collected in the Eastern Cape province have characteristics associated with *B. gibba* and *B. navicularis* or *B. compressidens*. These specimens are less hairy and greener in appearance. The flowers are pink and green (as is common in *B. navicularis* and *B. compressidens*) rather than purple to mauve and green (as is the case in *B. gibba*). The corolla is spreading (as in *B. navicularis/B. compressidens*) and seldom reflexed (as in *B. gibba*). The gibbosity on the corona-lobe keel is reduced in size, the upper distal corona-lobe appendage is shorter and bends away from the flower center to expose the style-apex. In one specimen (*Acocks 20142*) a small transverse flap was found inside the corona-lobe sinus; a feature of *B. compressidens* (fig. 27).

Specimens: South Africa — Easter Cape: *Bakelmann 7-Plat 41*, Gonubie Flats [NBG]; *Flanagan 1615*, Broughton near Molteno [BOL]; *Acocks 20142*, Barkly East [PRE].

B. navicularis* X *B. compressidens

Three specimens examined show characters that are intermediate between *B. navicularis* and *B. compressidens*. In these specimens the corona-lobes are level with the style-apex and the upper proximal and distal ends are level with each other; as in *B. navicularis*. However, the transverse shelf of tissue within the corona-lobe sinus has been greatly reduced or replaced by a tongue-like flap of tissue; as in *B. compressidens* (fig. 27). The suspected hybrid specimens are sympatric with the putative parent species.

Specimens: Eastern Cape: *Acocks 20236*, near Cathcart [PRE]; *Compton 19089*, Frasers Camp [NBG]; *Barker 1423*, East London [NBG]; *Bakelmann s.n.*, without precise locality [NBG].

B. gibba* X *B. disparilis

A specimen collected near Clydesdale by Tyson is intermediate in morphology between *B. gibba* and *B. disparilis*. Both of these species occur in the Clydesdale area and the Tyson specimen may represent a hybrid (fig. 27).

Specimen: South Africa — Eastern Cape: *Tyson 2151*, near Clydesdale [BOL].

TRACHYCALYMMA (K. Schum.) Bullock, in Kew Bull. 1953: 348 [1953]. **Type Species:** *Trachycalymma cristatum* (Decne.) Bullock (basionym: *Gomphocarpus cristatum* Decne.).

Gomphocarpus E. Mey. subsect. *Trachycalymma* K. Schum., in Engler & Prantl, Nat. Pflanzenfam. 4(2): 236 [1895]. **Type species:** As above.

Discussion: Originally thought to occur in South Africa (Arnold & de Wet 1993) due to the fact that some specimens of *Aidomene oreophila* (housed at PRE) had been wrongly identified as *Trachyclaymma pulchellum* (Decne.) Bullock. Also, *T. cucullatum* (a species that can be found in southern Africa, but which is not endemic to the subcontinent) was placed in this genus by Bullock (1956). However, it does not belong here and, for reasons outlined later, we have placed it in the genus *Aidomene*. The genus *Trachycalymma* does not occur in southern African. Rather, it is confined to tropical, east and west Africa. A revision of the genus is being prepared by Goyder. The genus *Trachycalymma* is discussed in more detail under *Aidomene*; to which it is allied.

AIDOMENE Stopp, in Bot. Jahrb. 87(1): 17 [1967]. **Type species:** *Aidomene parvula* Stopp.

Description: *Habit:* Perennial, geophytic herb; with milky latex. *Rootstock* usually a single cylindrical deep-seated narrow fleshy stem-tuber, rarely a small globose or carrot-like stem-tuber, 2.0—25mm wide. *Stems* 1—50 per plant, 30—600mm long, erect to spreading-erect, sometimes graminaceous, flattend (& sometimes channelled) to teretee, monopodial or dichotomously branched, glabrous (at the base) or unifarious or bifariously scabrous, strigose or pubescent, rarely villous to velutinous, usually ubique apically. *Leaves* simple, entire, opposite, spreading to ascending, usually equally spaced along the stem, rarely concentrated towards the stem base blade usually linear, occasionally narrow-lanceolate to lanceolate, trullate or falcate, older leaves usually shorter than younger leaves, (2-) 4—105mm long, 0.3—4(-18)mm wide, older leaves smaller, apex acute to pointed, sometimes almost pungent, rarely rounded, base tapering, rarely auriculate, margins noticeably revolute, venation not pronounced except for the large, lighter colored midrib, 2° and 3° veins usually not visible (except in *A. humilis*),

both surfaces glabrous, adaxial surface & abaxial midrib scabrous, scabridulous or glabrate, abaxial surface glabrous, older leaves sometimes fugaceous; petiole sessile or up to 3mm long. *Inflorescences* umbel-like, 1—23(-39) per plant, 1—7 per stem, erect, terminal or terminal & extra-axillary, usually 4-flowered, rarely 5 or up to 10-flowered; peduncles 6—140mm long, glabrous or ubique to unifariously scabridulous, scabrous, pubescent, puberulent, tomentose or velutinous; bracts usually persistent (except subgenus *Scyphocalymma*), linear to linear-triangular, 1.2—6.2(-8.0)mm long, 0.1—0.6mm wide, abaxial surface & margins pubescent, puberulous, scabrous, scabridulous or pubescent, rarely villous to velutinous. *Flowers* rotate, 3—14mm high, 4—16mm wide, white, cream, pink, mauve, lilac, yellow or brown; pedices l6—18(-23)mm long. *Calyx* 5-merous, spreading to reflexed; lobes lanceolate, 1.1—5.4mm long, 0.6—2.6mm wide, apex pointed to acute, abaxial surface glabrous, adaxial surface scabrous, pubescent, tomentose, villous to velutinous, margins scabrous. *Corolla* 5-merous, spreading (catiliform) to reflexed; lobes lanceolate, narrow-ovate, ovate, oblong-ovate to elliptic, connate at their base, 3.0—7.8(-11.5)mm long, (1.2-)1.7—4.2(-5.5)mm wide, apex acute to pointed, rarely rounded, abaxial surface glabrous, adaxial surface scabrous, puberulent to pubescent, rarely vellutinous, concentrated in the center & near the apex, margins minutely scabrous. *Staminal-corona* 5-merous, arising at the gynostegial-column base or 1mm above it; lobes cymbiform, calceiform, cucullate to cyathiform, spreading erect to erect 1.6—8.5mm wide, (1.0-) 3.0—5.8mm wide, upper proximal ends obtusely rounded, shoulder-like, deltoid or blunt & arm-like, appendages up to 0.6mm long these are level with or project onto the style-apex (except *A. cucullata* in which they reach half-way up the gynostegial-column) & usually flexed inwards to meet, upper distal end is deltoid in shape, lanceolate or obtusely rounded, the upper margin straight, slanting & slightly concave or folded inwards, the outer keel is shallow & boat-like, rounded or straight & more or less square, outer keel eventually forms a basal transverse ridge or, in some species, a marsupium that act as guide-rails during pollination, the sinus is a narrow central channel or sac-like, 1.1—2.7mm deep, with or without glands; but without large visible papillae. *Staminal-column* 1.5—3.5(-5.5)mm tall; anther-wing base rounded & shoulder-like or beak-like, outer margin obliquely slanted, slightly concave near the apex or straight throughout, 0.7—1.6mm long, 0.3—1.1mm wide; anther-appendages ovate,

depressed ovate, ligulate or reniform, 0.3—1.2mm long, 0.5—2.1(-3.5)mm wide, apex entire, rarely emarginate, membranous, white, decumbent on style-apex or on it's side. *Pollinaria*: Pollinia solitary & pendulous in each anther-sac, hemipyriform, clavate, lacrimiform or semi-circular, the outer margin rounded, the inner margin straight; translator-arms often long, geniculate & with transparent margins, attached apically to the pollinia; corpusculum ovoid, sometimes with 2 membranous wings. *Style-apex* usually truncated & concave centrally, rarely conical, with a small pore, margins thickened & undulate (elevated above the stigmatic ridges), 1.2—2.4(-3.4)mm in diameter. *Fruits:* erect, usually one by abortion, fusiform to almost linear-fusiform & teretee, 34—100mm long, 2.5—12mm wide, sometimes slightly falcate, apex acutely beaked, surface smooth; fruiting pedicel elongated (20—24mm long) & curved with mature fruit held erect. *Seeds* obovoid to oblanceoloid, bifacial, dorso-ventrally flattened, 2.1—7.7mm long, 1.4—4.4mm wide, ± 1.3mm tall, abaxial surface convex, adaxial surface shallowly concave, surface rugose or favulariate, light brown to reddish brown.

Discussion: In southern Africa this genus is composed of four subgenera (*Aidomene*, *Astrocalymma*, *Scyphocalymma* and *Callocymbion*) and ten species. In subgenera *Astrocalymma* and *Scyphocalymma* the vegetative facie is similar, but they differ in their floral structure, in particular, the corona-lobe which is slipper-like in *Astrocalymma* and cup-like in *Scyphocalymma*. In subgenera *Aidomene*, *Astrocalymma* and *Callocymbion* the corona-lobe structure is similar, however, the corolla and, in *A. humilis* & *A. aurea*, the leaves and stems are different. More details concerning this genus are given under each subgenus. Stopp (1967) when he described the genus *Aidomene* mentions it similarity to *Trachycalymma* and, to some extent, *A. cucullata* and *A. oreophila* show some intermediate characteristics between these two genera. This may be due to an origin from a distant common ancestor. However, both *A cucullata* and *A. oreophila* clearly belong to *Aidomene* and to place them in *Trachycalymma* would destroy the integrity of that genus. *Aidomene* can be clearly distinguished from *Trachycalymma* using a number of important diagnostic characters (Table 7). Some of the characters given in this table for *A. cucullata* can break down in tropical Africa: Here the peduncles can be of unequal length and arranged corymbosely on the stem, and stems may be more than 3 per plant. For the most part, however, in combination this correlated set of characters helps

maintain the integrity of the two genera. Stopp (1967) also suggests that *Aidomene* may be related to *Margaretta* and *Pachycarpus* but we believe any realtionship here to be very distant.

Distribution: Widespread in the eastern half of the southern African subcontinent, occurring from the Eastern Cape to Northern Province. Also in south central and tropical east Africa.

TABLE 7: List of characters that separate *Aidomene* from *Trachycalymma*.

Character	*Aidomene*	*Trachycalymma*
Stems number	1 to 50	1 (rarely up to 3)
Stem orientation	Spreading or erect	Erect only
Peduncle length	Not sbequal (not corymbose on the plant)	Subequal, so flowers all more or less at same level (held corymbose on the plant)
Corona-lobe size	Usually large	Small
Corona-lobe shape	Slipper-shaped, cup shaped or cucullate	Subcucullate or subglobose
Large corona sinus papillae	None	Present or absent

Key To The Subgenus:

1a. Corona-lobes cyathiform, 1.0—2.2mm wide. Anther-appendages depressed reniform with the apex shallow concave. Inflorescence bracts caducous, not present after anthesis ..... Subgenus *Scyphocalymma*

1b. Corona-lobes cymbiform (slipper-shaped), calceiform or cucullate, 2.0—7.5mm wide. Anther-appendages ovate & leaf-like. Inflorescence bracts persistent after anthesis 2

2a. Petals 8—12mm long. If corolla purple then leaves 19—75mm wide, if corolla ivory, whitish-pink & mottled with irregular purple blotches

then leaves 1.2—7.0mm wide ..... Subgenus *Callocymbion*

2b. Petals 1.2—7.0mm long. Corolla purple, purple-green, purple-brown, purple-white or yellow, never mottled. Leaves never wider than 4mm 3

3a. Plants not tall (30—295mm) & graminaceous. Peduncles seldom more than 45mm long. Flowers purple-green, purple-brown or purple-white. Pollinia lacrimiform or tear-drop-shaped ..... Subgenus *Astrocalymma*

3b. Plants tall (145—600mm) & graminaceous. Peduncles 50—148mm. Flowers white, yellow or orange. Pollinia hemispherical ..... Subgenus *Aidomene*

AIDOMENE* Stopp Subgenus *AIDOMENE

Description: *Rootstock* a solitary narrow fleshy cylindrical deep-seated or small globose or carrot-like stem-tuber, 2.0—11.0mm wide. *Stems* 1—6 per plant, 145—600mm long, erect, graminaceous, teretee & monopodially branched. *Leaves* equally spaced along the stem; blade linear, 6—85mm long, 0.8—1.5mm wide, apex acuminate, sometimes almost pungent, base tapering, venation not pronounced except for the large lighter colored midrib, both surfaces glabrous; petiole sessile or up to 2mm long. *Inflorescences* 1—14 per plant, 1—7 per stem, usually 4-flowered, rarely 5 or up to 8-flowered; peduncles 44—140mm long; bracts usually persistent, 1.2—6.2mm long, 0.1—0.45mm wide. *Flowers* 3—10mm high, 4—11mm wide, yellow, yellow-gray, yellow-mauve to whitish; pedice 6—17mm long. *Calyx* 1.7—4.1mm long, 0.6—1.5mm wide. *Petals* lanceolate to ovate, 3.0—5.7mm long, 1.7—3.3mm wide, apex acute. *Staminal-corona* arising at the gynostegial-column base; lobes cymbiform to calceiform, spreading erect, 1.6—2.5mm wide, 3.0—5.8mm wide, upper proximal ends obtusely rounded, shoulder-like, deltoid or blunt, these are level with or project onto the style-apex, the upper margin straight, slanting & slightly concave, the outer keel shallow & boat-like, sinus is a narrow central channel, 0.9—2.5mm deep. *Staminal-column* 2.0—2.5mm tall; anther-wing base rounded & shoulder-like 0.7—1.2mm long, 0.3—0.5mm wide; anther-appendages ovate to depressed ovate, 0.3—0.8mm long, 0.6—0.9mm wide, apex entire, decumbent on style-apex. *Pollinaria*: Pollinia semi-circular. *Style-apex* truncated & centrally concave, 1.2—

2.2mm in diameter. *Fruit:* linear fusiform, 42—80mm long, 2.5—6.0mm wide, sometimes slightly falcate.

Distribution: South Africa, Zimbabwe, Botswana and Angola.

Discussion: This is a subgenus of two species (*A. parvula* and *A. aurea*). It differs from the other subgenera in the plants being graminaceous, stems tall (145—600mm), erect, thin and monopodially branched. The internodes are very long; often longer than the leaves. The leaves are narrowly-linear almost filiform (0.8—1.5mm wide). The peduncles are very long (44—140mm). The flowers are bright yellow to off-white. The pollinaria are delicate and the pollinia are semi-circular with the inner margin straight and the outer margin round. Follicles are narrowly linear and sometimes falcate (2.5—6.0mm wide). In many ways, especially the long peduncles, elongated distal corona-lobe structure (in some specimens), and yellow flower color, this species bears some resemblance to the genus *Stathmostelma*. In fact, Brown (1902) placed *A. aurea* at the end of a series of species of *Asclepias* now placed in *Stathmostelma*. However, vegetatively, as well as in many floral characters (including a quite differently shaped pollinarium) *A. aurea* does not fit in *Stathmostelma* at all. As a result, we have decided to treat any similarities as homoplasious (i.e. due to convergent evolution). The taxonomy of *Stathmostelma* has been comprehensively dealt with by one of the authors (Goyder 1998).

In common with subgenus *Astrocalymma* and *Callocymbion* the flowers are stellate in appearance but *Aidomene* differs from both vegetatively (as mentioned above), in flower color and also pollinarium structure.

1. ***Aidomene aurea*** (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 580,* South Africa, Mpumalanga province, Barberton [Holo. B†. Iso. GRA, PRE].

Gomphocarpus aureus Schltr., in Engl., Bot. Jahrb. 18(5). Beibl. 45: 17 [1894]. **Type**: As above.

Asclepias aurea (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type**: As above.

Asclepias aurea (Schltr.) Schltr. var. *brevipcuspis* S. Moore, in Journ. Bot.: 255 (1902). **Type:** *Rand 638*, Zimbabwe, Harare [Holo. BM].

Asclepias aurea (Schltr.) Schltr. var. *vittata* N.E. Br., in Fl. Cap. 4(1): 686 [1908]. **Type:** *Galpin 500*, South Africa, Mpumalanga province, Saddleback Mountain near Barberton, 3000—4000ft (= 914—1219m) [Lecto. K. Isolecto. PRE, SAM]. *Cooper s.n.*, Lesotho, without precise locality [Syn. *n.v.*]. *Richardson s.n.*, Free State, Bethlehem [Syn. *n.v.*]. *Wood 4555*, South Africa, KwaZulu-Natal province, Biggars Berg [Syn.. K. Isosyn. NH]. *Wood 5892*, South Africa, KwaZulu-Natal province, near Newcastle [Syn. *n.v.*]. *Bolus 12152*, Swaziland, between Carolina & Mbabane, 5000ft (= 1524m) [Syn. BOL]. *Miller s.n.*, Swaziland, Mbabane [Isosyn. PRE].

Gomphocarpus schizoglossoides Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 21 [1894]. **Type:** *Galpin 500,* South Africa, Mpumalanga province, Saddleback near Barberton [Holo. B†. Iso. K, PRE, SAM] (fig. 35).

Schizoglossum pedunculatum Schltr., Verhandl. Bot. Ver. Brandenb. 35: 50 [1894]. **Type:** *Schlechter 351,* South Africa, Western Cape province, Cape Town [Holo. B† Iso. BOL].

Discussion: The graminaceous habit so characteristics of this species (fig. 28) is probably an adaptation to living in unburnned grasslands, the tall stems and long peduncles enable the plant to hold the flowers above the grassline where they can be more easily seen by pollinators.

After examining a large number of specimens (over 160) we have been unable to uphold Brown's (1908) variety *vittata*. The dark colored dorsal stripe he used as a distinguishing characteristic seems primarily to be an artifact produced in pressed specimens only and the length of the distal appendage is so variable that it cannot be used to distinguish infraspecific taxa. Our studies show one large variable taxon. However, specimens from Zimbabwe and some from Swaziland are slightly different to South African specimens, but these differences are minor and occurs along morphoclines with no discontinuity. In general, specimens occuring in Swaziland are more robust than elsewhere. In these specimens the leaves, peduncles, petals, anther-wing length, anther-appendages and translator-arms are longer. The flowers, including the corona-lobes, are larger and often more saccate than slipper-like. The distal end of the corona-lobes are often tapering filiform erect and with a deeper sinus. B. Maguire also noticed that some Swaziland specimens were different and pointed out in notes attached to herbarium

specimens he consulted (*Compton 24500 & 24516* in NBG) that they do not fit Brown's 1908 description. He suggests that they represent a yet undescribed form near variety *vittata*. Although a good case could be made for assigning the Swaziland form a name, we have choosen at this time not to do so. This decision is primarily based on our opinion that we do not yet have enough data and the fact that not all Swaziland specimens are different from the typical form. Also the Swaziland specimens are linked to the typical form by, albeit, a very few intermediates. The specimens in Zimbabwe also differ from their southern African populations in having larger leaves (up to 20mm longer) that are always apetiolate, much shorter peduncles (up to 55mm shorter) and slightly bigger flowers. Moore (1902) described the variety *brevicuspis* to accommodate some Zimbabwe specimens that had shorter corona-lobes, but we have, like Brown (1902), found this to be an inconsistent character. Following Brown we have not upheld this variety.

The type of *Schizoglossum pedunculatum* (seen by us) belongs to *S. aurea* (a diagnosis also shared by Brown, 1908). Schlechter says he collected the specimen in Cape Town, but this is unlikely as all other collections of this species come from the summer rainfall region some 500 kms to the east. Flowers, although usually yellow in color (fig. 28), also exhibit white tinted purple forms. A number of specimen may represent possible hybrids between *A. aurea* and *A. stellifera*; see under *A. stellifera*.

This species grows in open, usually unburned, highveld grasslands, often on stony hillsides. This species flowers between September and December, and occurs at altitudes of between 1000 and 2000 meters, rarely as low as 750 meters. Ethnobotanically these plants are used as an emetic and the Sotho name *Mohlatsisa* ("he who causes vomiting") refers to this. Despite this purgative effect the rootstock is apparently eaten as a vegtable.

Distribution: African endemic. Found in Lesotho, South Africa [Northern, North-West, Gauteng, Mpumalanga, Free State, Kwazulu-Natal & Eastern Cape provinces], Swaziland and Zimbabwe (fig. 31). Bruyns (1995) reports the occurence of this species in the Northern Cape province and in Namibia, but we have not had access to these specimens.

Conservation Status: Not threatened, although rare and vunerable in many areas.

Representative Specimens: Botswana: *Hilliard & Robertson 615*, Kanye, Lobatsi [PRE]. **Lesotho:** *Dieterlen 655* not of *Sigridia viridiflora*, Leribe [GRA, JF, NH, PRE, SAM, STE]; *Jacot-Guillarmod 3201,* Mamathes [PRE]. **Namibia:** *Seydel 4109*, near Windhoek [WIND specimen note seen, *fide* Bruyns 1995] **South Africa:** Northern: *Germishuizen 933*, Waterberg [PRE], *Laughton J32146*, Louis Trichardt [J]; *Onderstall 1261*, Kaapsche Hoop [PRE]; *Bloem 118*, Steenkampsberg Nature Reserve [PRE]; *Germishuizen 3404*, near Pietersburg [PRE]; *Jacobsen 3416*, Soutpansberg [PRE]. North-West: *Pegler 954*, Rustenberg [BOL, GRA, NH, PRE, SAM]; *Thode A1444*, Zeerust [NH, PRE]; *Rogers 18740*, Rustenburg [J]; *Germishuizen 4976*, Pilanesberg Game Reserve [PRE]; *Germishuizen 3967*, Schoomspruit, near Ventersdorp [PRE]; *Jacobsen 3509*, Bergkrans, Waterberg [PRE]. Gauteng: *Repton 640*, Wilge river near Pretoria [NH]; *Moss 2522*, Houghton Estate [J]; *Behr 793*, Wilropark, Roodepoort [PRE]. Mpumalanga: *Young A414*, Borchhoek near Lydenberg [NH]; *Thorncroft 25518*, Barberton [JF, STE], *Rogers 18335*, Sabie [J]; *Meyer 68*, Songimvelo Game Reserve, Kangwane [PRE]; *Venter 948*, Klipdraai farm, Serala forestry [PRE]; *Onderstall 848*, Rhenosterkop [PRE]; *van Hoepen 1733*, Brakfontein farm, Swartuggens [PRE]; *Stalmans 193*, Lekgalameestse Nature Reserve [PRE]; *Matthew 963*, Sheepmoor area [PRE]; *Hilliard & Burtt 18544*, Rustfontein farm, Wakkerstroom district [NU]; *Hilliard & Burtt 18427*, 8kms south of Moolman turn off on Paulpietersburg- Piet Retief road [NU]. Free State: *A. Nicholas with G. Nicholas 1061*, Kerkenberg [CPF, MO, NH, NU]; *du Preez 335*, Vredefort [BLFU]; *Pont 303*, Kroonstad [BLFU, PRE]. KwaZulu-Natal: *Goyder with Nicholas, A. Nicholas with G. Nicholas 967*, Ntabamhlope [CPF, K, MO, NH, PRE], *Buthelezi 262*, On road to Nongoma [NH], *Schrire 1172*, Itala Nature Reserve [NH - with rootstock], *Wood 5892*, Near Newcastle [BOL, NH - with flower & fruit]; *Schlechter 3409*, Newcastle [BOL, GRA, NH, PRE]; *Wood 4555*, Biggarsberg [K, NH]; *A & G. Hutchings 2558*, Itala Reserve [KEI]; *Germishuizen 2265*, near Vryheid [PRE]; *Kok & Pienaar 1277*, Paulpietersburg [PRE]; *Davis 225*, Hilton college [NU]; *Cunningham 878*, Ngongwana mountain [NU]; *Hilliard & Burtt 18561*, Retirement farm, Utrecht district [NU]. Eastern Cape: *Galpin 5793*, Rooiwal river [PRE]. Northern Cape: *Bruyns 5836*, near Kuruman [BOL specimen not seen, *fide* Bruyns 1995]. **Swaziland:** *Stewart 8778*, without precise locality [GRA]; *Schlieben 9501*, Mbabane [PRE]; *Heath 608*, Malolotja

Figure 29. *Aidomene aurea*: a. Whole plant showing habit & habitat (1 meter tall); b. & c. Close up of flowers showing color variation. *A. revoluta*: d. Whole plant showing habit (200mm tall), note the narrow cylindrical fleshy stem-tuber indicated with an arrow; e. Close up of flowers. Photographs: a, b, d & e by A. Nicholas; c by M. Von Fintel .

Nature Reserve [PRE]. **Zimbabwe:** *Goodier & Phipps 242*, Bundi plain, Melsetter [PRE, SRGH]; *Wordswoth 4*, Somabula flats [JF, STE]; *Rand 638*, Harare [BM]; *Eyels 1938*, Harare [PRE, SAM]; *Drummond 5070*, Near Eagles Nest [PRE, SRGH].

Representative of Swaziland Form — South Africa Mpumalanga: *Codd & de Winter 4939*, Near Pretorius Kop, Kruger National Park [PRE]; *Pott 5365*, Barberton [PRE]; *Thorncroft 25518*, Barberton [J]. Swaziland: *Dlamini s.n.*, Devils Bridge [NH 111019]; *Compton 27214*, Near Mbabane [NBG, PRE]; *Compton 24614*, Ukutula [NBG, PRE].

AIDOMENE* Stopp Subgenus *ASTROCALYMMA* Nicholas & Goyder. *Subgen. nov. ***Radi*** *caudex unicus, tumidus lignosus, profunda infossus.* ***Caule*** *1—50 in planta, 30—520mm longi, erecti vel effusi.* ***Folia*** *patentia vel ascendentia, 2—105mm longa, 0.3—4.0mm lata, plerumque lineara, interdum angusta lanceolata ad lanceolata, marginibus revolutis.* ***Inflorescentia*** *terminalis vel terminalis et extra-axillaris, bractis persistentibus, pedunculo* 6—98mm longo. ***Flores*** *ut videtur stellaeformes, plerumque 4 in inflorscentia.* ***Coronae lobi*** *cymbiforme vel cucullati; sinus canale angusto centrali vel saccato. Antherae appendicis ovatis ad depressus.* ***Gynoecii*** *apex applanatus, undulatus, margine incrassato.* ***TYPUS:*** *Aidomene revoluta* (E. Mey.) Nicholas & Goyder, *vide infra.*

Description: *Rootstock* usually a solitary narrow fleshy cylindrical deep-seated stem-tuber, 2—24mm wide. *Stems* 1—30(-50) per plant, 30—350mm long, erect to spreading-erect, flattend & usually channelled, monopodial or dichotomously branched. *Leaves* usually equally spaced along the stem, rarely concentrated towards the stem base; blade usually linear, occasionally narrow-lanceolate to lanceolate, trullate, (2-)4—105mm long, 0.3—4.0mm wide, base tapering, rarely auriculate, venation not pronounced except for the large midvein, rarely 2° & 3° veins visible; petiole sessile or up to 3mm long. *Inflorescences* 1—39 per plant, 1—7 per stem, usually 4-flowered, rarely 5 to 10-flowered; peduncles 6—98mm long; bracts usually persistent, linear to linear-triangular, 1.5—8.0mm long, 0.1—0.6mm wide. *Flowers* 3—14mm high, 4—16mm wide, pink, mauve, lilac; pedicel 6—14mm long. *Sepals* 1.1—5.4mm long, 0.7—2.6mm wide. *Petals* ovate to elliptic, 3.0—7.6mm long, 1.2—5.2mm wide. *Staminal-corona* arising at the

gynostegial-column base or 1mm above it; lobes cymbiform to cucullate, spreading erect to erect, 2.7—7.5mm long, upper proximal end obtusely rounded, shoulder-like or deltoid, these level with or projecting onto the style-apex (except *A. cucullata* in which they reach half-way up the gynostegial-column) & usually flexed inwards to meet, upper distal end is deltoid in shape, lanceolate or obtusely rounded, rarely bifid, the upper margin straight, slanting & slightly concave or folded inwards, the outer keel shallow & boat-like or rounded, the sinus is a narrow central channel, 1.1—3.4mm deep. *Staminal-column* 1.5—5.5mm tall; anther-wings 1.0—1.6mm long, 0.3—0.9mm wide; anther-appendages ovate to depressed ovate, 0.4—1.0mm long, 0.65—1.6mm wide, apex entire, rarely emarginate. *Pollinaria*: Pollinia clavate or lacrimiform. *Style-apex* usually truncated, rarely conical, 1.0—3.4mm in diameter. *Fruit:* fusiform, 34—100mm long, 5—12mm wide; fruiting pedicel elongated (20—24mm long). *Seeds* 2.1—7.7mm long, 1.6—4.4mm wide.

Discussion: The stellate flower shape, hence the subgeneric name *Astrocalymma* (from the Greek *astro* = star and *calymma* = hood), and slipper-like corona-lobe of this taxon is very characteristic and very constant. The only exception is *A. cucullata* where the distal part of the corona-lobe is inflexed to give the corona a typical cucullate appearance; because of this, the flower loses it typical stellate shape. In fact, because floral structure (not just corona-lobe structure) is so consistent a case could be made for sinking all species (except *A. cucullata*) into one species divided into several subspecies. However, we believe that by doing this we will lose information about diversity (with so much of the Earth's biodiversity and genetic diversity becoming extinct we do not believe this to be a viable option) and that the end product will be less useful to consevationists, ecologists and the growing base of ordinary people interested in knowing and identifying the plants they find around them.

The stellate-flower structure of this subgenus is similar to that found in subgenera *Aidomene* and *Callocymbium*. However, it differs from these vegetatively.

Key to species:

1a. Corona-lobe helmet-shaped (cucullate), as long as tall ..... A. *cucullata*

1b. Corona-lobes slipper-shaped (calceiform–cucullate), longer than tall 2

2a. Corona-lobes 5.0—7.5mm long, 2.6—3.8mm high,
petals 6.0—7.5mm long ..... *A. revoluta*
2b. Corona-lobes 1—5mm long, 1.0—2.6mm high, petals 3—6mm long 3

3a. Mature plants with 10 to 50 stems ..... *A. meyeriana*
3b. Mature plants with 1 to 9 stems 4

4b. Plants 75—114mm tall ..... *A. velutina*
4b. Plants 120—300mm tall 5

5a. Peduncle 7—53mm long ..... *A. revoluta*
5b. Peduncle 0.6—5.0mm long ..... *A. brevipes*

2. *Aidomene revoluta* (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Type:** *Drége 3425*, South Africa, Eastern Cape province, near Schiloh [Holo. B† Iso. P, PRE] (fig. 30).

Lagarinthus revolutus E. Mey., Comm. Pl. Afr. Austr. 205 [1838]. **Type:** As above.

Gomphocarpus revolutus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias stellifera Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Type:** As above.

Gomphocarpus simplex Schltr., in Engl., Bot. Jahrb. 18(5). Beibl. 45: 21 [1894]. **Type:** *Galpin 552*, South Africa, Mpumalanga province, Saddleback mountains near Barberton. [Holo. B† Iso. K, PRE].

Asclepias simplex (Schltr.) Schltr., J. Bot., Lond. 34: 455 [1896]. **Type:** As for *Gomphocarpus simplex.*

Discussion: The flowers have a reflexed corolla which exposes the large stellate and colorful corona; which is, as a result, usually the first part of the flower observed (fig.

29). It is thus unfortunate that the epithet *revoluta* (which refer to the revolute leaf margin) has had to replace the more well known and more widely used *stellifera*. Specimens collected in the north of the subcontinent are generally larger and more branched than those found in the south. This species is usually found growing in open midland or highland grassveld, very often in stony ground or occuring in annually burned areas where, if this co-incides with the first rains, it comes up shortly after burning. Occasionally found in dry sparse scrubveld. A widespread species flowering between September and January, and found at altitudes of between 1000 and 2100 meters. Strangely, for a species of such widespead occurence, it does not seem to be used medicinally.

A number of specimens exsist that are intermediate between this taxon and *A. brevipes*, *A. meyeriana*, *A. aurea* and *A. cucullata* suggesting that hybridization occurs between these (fig. 23). A form of *A. revoluta* that occurs in Zululand (Ubombo area) differs from the typical form in having a quite different habit, flower structure and in being very hairy almost velutinous (in this last character it approached *A. velutina*). These specimens are so distinct that a case could be made for giving this restricted ecotype some form of nomenclatural recognition. However, we have opted not to take this route until we have more data. Specimens for both the suspected hybrids and the Zululand ecotype are given separately below.

Distribution: Southern African endemic. Botswana, Lesotho, South Africa [Northern, North-West, Gauteng, Mpumalanga, Free State, Eastern Cape and KwaZulu-Natal provinces] and Swaziland (fig. 32).

Conservation Status: Not threatened, although vunerable in some areas such as around the mega Johannesburg-Pretoria conurbation now with a population of some 9 million people.

Representative Specimens: Botswana: *Coetzee 153* [PRE]. **Lesotho:** *Strever 1270*, Quachsnek, Bramwell valley [NH]; *Jacot Guillarmod 519*, Mamathes [PRE]; *Dieterlen 261*, Leribe [PRE, SAM]; *Richardson 178*, Pontseng woodlot [NU]. **South Africa:** Northern: *Burtt Davy 3239*, Waterberg [PRE]; *Stalmans 1626*, Lekgalameestse Nature Reserve [PRE]; *Venter 7167*, The Downs farm, Crows Nest [PRE]. North West: *Smith 6297*, Potchefstroom [PRE]. Gauteng: *Schlechter 3491*, Suikerbosrand/Watervaal river

[GRA, NH, PRE]; *Hutton 619*, Florida [BOL, GRA, PRE]; *Prosser 1295*, Observatory [J, NBG]. Mpumalanga: *Rogers 2558*, Witbank [GRA]; *Thorncroft 1174*, Lomati Valley, Barberton [K, PRE]; *Cameron 5658*, Volksrust [PRE]; *Cameron 200*, Dullstroom [PRE]; *Hardy 6863*, Saw Mill, near Mariepskop [PRE]; *Drews 88*, Groot-Suikerboskop [PRE]; *Hilliard & Burtt 18494*, Barberton, above Lone Tree Hill [NU]. Free State: *du Preez 1156*, Korannberg [BLFU]; *Potts 3203*, Kinklington [BLFU]; *Potts 4977*, Bloemfontein [BLFU, PRE]; *Barker 10098*, Harrismith [NBG]; *Richardson 154*, Ladybrand [NU]; *Blom 180*, Sterkfontein Dam [PRE]; *Zietsman 495*, Korannaberg, Excelsior [PRE]. KwaZulu-Natal: *Nicholas 926*, Near Coleford Nature Reserve [CPF, K, MO, NH, NU]; *Nicholas 928*, between Underberg & Colford [CPF, K, NH, MO, NU]; *Nicholas 933*, between Underberg & Colford [NU]; *Nicholas 949*, Mooiriver [CPF, NU]; *Fannin 17*, Dargle farm [TCD]; *Nicholas 1103 with Gibbs*, Cobham State Forest [CPF, PRE]; *Nicholas 2841*, Sani Pass [UDW]; *Nicholas 2766 with Porrun & Govender*, Loteni [UDW]; *Nicholas 2770 with Poorun*, [UDW]; *Nicholas 2748 with Poorun*, Sani Pass [UDW]; *Nicholas 2755 with Poorun & Govender*, Kamberg [UDW]; *Venter 3911*, Empangeni Lake [BLFU]; *Wood 11213*, Tabamhlope [BOL, NH, PRE, SAM]; *Ward 2281*, Huhluwe Game Reserve [NH, NU]; *van Wyk 7266*, Nuze river valley [NH, PRU]; *Williams 323*, Babanango, Goudhoek farm [NH, PRE]; *Kennedy 5*, Cathedral Peak State Forest [NU]; *Martin 466*, Cannible cave, near Bergville [NBG]; *Manning & Balkwill 355*, Lanner Veane farm, near Mooiriver [NU]; *Balkwill, Manning, Getliffe Norris & Marchant 1029*, between Sani Pass & Nottingham Road [NU]; *Germishuizen 2304*, near Vryheid [PRE]; *MacDevette 2038*, Sani Pass [PRE]; *Stirton 9036*, Mikes Pass, Cathedral Peak [PRE]; *Smit 1245*, Chelmsford Park [PRE]; *Jordaan 670*, Nsuze Valley [PRE]; *Stirton 8181*, between underberg & Swartberg [PRE with good rootstock]; *Stutterheim 34*, Kamberg [PRE]. Eastern Cape: *Bester 982*, Maclear, Farm Fair valley [NH]; *Barber/Bowker 784*, Tsomo river [GRA, TCD]; *Phillipson 1133*, Amatole mountains, Hogsback [UHF]; *Bolus 6843*, Eland's Hoek, near Aliwal North [JF, STE]; *Hutchings & Phillipson 1800*, Hogsback [KEI]; *Tyson 1532*, Kokstad [SAM]; *Galpin 1601*, Fincham's Nek [PRE]; *van Wyk 247*, near Cala Town [GRA]; *Strever 301*, York [PRE]. **Swaziland:** *Compton 24514*, Ukutula [NBG]; *Heath 363*, Malolotja Nature Reserve [PRE]; *Compton 28096*, Dalriach [PRE]; *Compton 28170*, near Mbabane [PRE].

Possible hybrids between *A. revoluta* & *A. aurea:*

South Africa: Gauteng: *Heatley & Moss 2761*, Johannesberg [J]. KwaZulu-Natal: *Shirley s.n.*, near Dundee [NU]. Lesotho: *Gormley & Barber 17*, Ha Khotso [PRE] (fig. 39).

Possible hybrids between *A. revoluta* & *A. brevipes:*

South Africa: North-West: *Burtt-Davy 1818*, Potchefstroom [PRE]; *Coetzee 420*, Rustenburg [PRE]. Gauteng: *Fairall 230*, Waterkloof, Pretoria [NBG]. Mpumalanga: *Steyn 991*, Ermelo, Breyten [NBG]; *Moss 11281*, Houghton [J] (fig. 39).

Possible hybrids between *A. revoluta* & *A. meyeriana:*

South Africa: North-West: *Sutton 687*, Boskuil [PRE] (fig. 39).

Possible hybrid between *A. revolute* & either *A. brevipes* or *A. meyeriana:*

South Africa: North-West: *Bennett s.n.*, Krugersdorp [BOL]. Gauteng: *Eshuis s.n.*, Pretoria [PRE 51561]. Without precise locality: *McLea s.n.* Transvaal [BOL 5709]; *Ecklon & Zeyher s.n.* [BOL] (fig. 39).

Possible hybrid between *A. revoluta* & *A. cucullata:*

South Africa: Northern: Galpin 9147, Pyramid Estate [PRE]. Gauteng: Gilliland 25978, Frankenwald [PRE].KwaZulu-Natal: *Nicholas 2750 with Poorun & Govender*, Giant's Castle [UDW]. Pitts s.n., Killarney [J]; Pitts s.n. [ex Moss], Kilarney [J A5 — this might rather be a hybrid between *A. cucullata* & *A. meyeriana*?]

Zululand Ecotype:

South Africa: KwaZulu-Natal: *Ward 3548*, Mkuzi Game Reserve [MKUZI, PRE]; *A & G Hutchings 2467 & 2490*, Babanango, Goudhoek farm [ZULU]; *Gerstner 3482*, Eshowe [NH].

Table 8: Comparison of species in subgenus *Astrocalymma* (all measurements in mm)

Character	*A. stellifera*	*A. velutina*	*A. meyeriana*	*A. brevipes*	*A. cucullata*
Stems per plant	1 to 13	1 to 8	2 to 50	1 to 7	1 to 4
Plant height	120 to 290	75 to 114	100 to 260	120 to 295	170 to 350
Vestiture	Scabrous to pubescent	Densely pubescent	Scabrous to pubescent	Strigose to pubescent	Scbridulous to pubescent
Leaf length	8 to 105	25 to 53	6 to 80	12 to 79	7 to 105
Leaf width	0.5 to 3.0	0.5 to 1.8	0.3 to 2.4	0.8 to 2.0	0.3 to 4.0
Petiole length	0 to 3	0 to 3	0 to 2	0 to 2	0 to 3

Peduncle length	7 to 53	8 to 34	7 to 38	6 to 48	12 to 98
Flower width	5.0 to 16.0	8.0 to 11.0	4.5 to 8.0	4.0 to 7.5	7.0 to 13.0
Sepal length	2.2 to 4.7	1.1 to 5.4	1.7 to 3.4	4 to 7	2.5 to 5.4
Petal length	3.0 to 6.0	5.5 to 6.0	3.3 to 5.0	3.0 to 6.0	6.2 to 7.6
Staminal-column height	2.5 to 3.5	2.5 to 3.5	1.5 to 2.0	2 to 3	2.5 to 5.5
Corona-lobe shape	Slipper-shaped	Slipper-shaped	Slipper-shaped	Slipper-shaped	Cucullate
Corona-lobe length	4.0 to 7.5	4.0 to 5.0	3.6 to 4.2	2.7 to 5.4	2.5 to 4.9
Corona-lobe sinus depth	2.0 to 2.7	1.6 to 2.6	1.1 to 1.8	1.3 to 2.6	2.0 to 3.8
Anther-wing length	1.0 to 1.5	1.1 to 1.6	0.9 to 1.3	1.0 to 1.3	1.3 to 1.6
Anther-wing width	0.3 to 0.7	0.4 to 0.7	0.4 to 0.6	0.35 to 0.5	0.5 to 0.9
Anther appendage shape	Broad ovate	Ovate to depressed ovate	Ovate	Depressed ovate	Depressed ovate
Anther appendage length	0.4 to 1.0	0.4 to 0.9	0.48 to 1.0	0.4 to 0.6	0.4 to 1.0
Anther appendage width	0.65 to 1.5	0.6 to 0.9	0.5 to 1.0	0.6 to 1.0	1.0 to 1.6
Translator-arm length	0.16 to 0.32	0.24 to 0.28	0.2 to 0.36	0.2 to 0.28	0.24 to 0.48
Pollinia length	0.76 to 1.08	0.72 to 0.8	0.64 to 0.92	0.72 to 0.96	0.88 to 1.08
Pollinia width	0.08 to 0.12	0.12 to 0.16	0.1 to 0.16	0.3 to 0.44	0.4 to 0.52
Style-apex diameter	1.3 to 2.4	1.5 to 1.7	1.0 to 2.2	1.1 to 2.2	2.3 to 3.4

3. ***Aidomene velutina*** (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 450*, South Africa, Mpumalanga province, Saddleback near Barberton [Holo. B† Iso. PRE] (fig. 31).

Gomphocarpus velutinous Schltr., in Engl., Bot. Jahrb. 18(5). Beibl. 45: 22 [1894]. **Type:** As above.

Asclepias velutina (Schltr.) Schltr., J. Bot., Lond. 34: 454 [1896]. **Type:** As above.

Discussion: Morphologically this species can be distinguished from *A. revoluta* only by its dense covering of long white hairs and there might be some grounds for sinking it, at a lower rank, under that species. However, because it can be recognized immediately as different, and because it is endemic to serpentine areas around Barberton, we have

decided to maintain it is a distinct species. Also, by sinking it under *A. revoluta* information such as its unusual ecological preference and thus its unique genetic constitution will be lost, as will its threatened conservation status.

As Brown (1908) points out, that the specific epithet *velutina* suggests that the hairs are velverty, but they are, in fact, quite harsh. *A velutina* flowers slightly earlier than most other species in this genus, August to September, this combined with its preference for serpentine soils has probably prevented hybridization with *A. revoluta*, which occurs close by, or with any hybridizes with many other member of *Aidomene*. Plants occur at altitudes of between 900 and 1200 meters.

Distribution: South African endemic [Mpumalanga province only] (fig. 32).

Conservation Status: Endangered. Because of its very restricted distribution and specific soil requirements (that we know of, only five species have so far been collected) this species must be considered endangered.

Representative Specimens: South Africa: Mpumalanga: *Onderstall 689*, Twello [PRE], *Thorncroft 644*, Barberton [NH]; *Thorncroft 2068*, Lomati Valley [PRE]; *de Souze 558*, near Barberton [PRE], *Nel 49*, Saddle Back Range [NBG].

4. ***Aidomene meyeriana*** (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Schlechter 3378*, South Africa, KwaZulu-Natal province, Colenso. [Holo. B† Iso. BOL, GRA, MEL *fide* Forster 1993, NH, PRE] (fig. 31).

Gomphocarpus meyerianus Schltr., in Engl., Bot. Jahrb. 20(5). Beibl. 51: 33 [1895]. **Type:** As above.

Asclepias meyeriana (Schltr.) Schltr., in Engl., Bot. Jahrb. 21(5). Beibl. 54: 8 [1896]. **Type:** As above.

Lagarinthus revolutus E. Mey. var. *minor* E. Mey., Comm., Pl. Afr. Austr. 205 [1838]. **Type:** *Drége 3436*, South Africa, Eastern Cape province, near Schiloh. [Holo. B† Iso. P, PRE.] (fig. 31)

Discussion: *A. meyeriana* differs from other species in the subgenus *Astrocalymma* by its smaller stature, much branched habit and xerophytic morphology (fig. 29). It was named after Ernst H.F. Meyer Professor of botany at Konigsberg university, Germany, who

wrote up Drége's South African collection (Meyer 1838). This species is found growing in open, sparsely covered grasslands, usually in dry, well drained soils and its unusual distribution in a band that runs across the central part of the subcontinent reflects this habitat preference. An outlying population in Swaziland may indicate that this species was more widespread in prehistorically drier times (fig. 32). Plants flower from September to February, and occur at altitudes of between 800 and 1500 meters. The south Sotho use a cold infusion, presumably of the roots, as a gargle for sore throat (Watt & Breyer-Brandwijk, 1962). The following coloqual names *molsukii*, *molsuku*, *molsukui*, *basoa* and *basou* occur on a specimen (n° 490) collected by Rev. Frici Christo (housed at SAM). This species may hybridize with *A. stellifera*; see under that species.

Distribution: Southern African endemic. Found in Lesotho, South Africa [North-West, Gauteng, Northern Cape, Free State, KwaZulu-Natal, and Eastern Cape provinces] and Swaziland (fig. 32).

Conservation Status: Threatened in KwaZulu-Natal, vunerable in many places elsewhere.

Representative Specimens: Lesotho: *Koopowitz s.n.*, Maseru [RUH]. **South Africa:** North West: *Burtt Davy 2168*, Potchefstroom [NH]; *Theron 441*, Christiana [PRE]; *Burtt Davy 11252*, Schweizer-Reneke [PRE]; *Burtt Davy 11744*, Christiana [PREE- fruit only]. Gauteng: *Gilfillan 7211*, Bezuidenhout Valley [PRE]; *Leeman s.n.*, Pretoria [PRE 51589]. Free State: *Pott s.n.*, Bloemfontein [BLFU]; *Pott 3822*, Vereeniging [GRA, SAM]; *Pont 229*, Kroonstad [BLFU]; *Barker 9852*, Smithfield [NBG]; *Moss 3215*, Bloemfontein [J]; *Goossens 491*, Heilbron [BLFU]; *Moss 13513*, Parys [J]; *Zietsman 78*, Glen Landbou Kollege, Bloemfontein [PRE]. KwaZulu-Natal: *Nicholas 956*, Colenso [CPF, MO, NH, NU]; *Nicholas 976*, near Ladysmith [NU]; *Ngwenya 1090*, Dannhauser, Fairbreeze farm [NH]; *Green 208*, Estcourt [NH]; *Repton 1156*, Muden Valley [NH, PRE]; *Geekie 35*, Ladysmith [NU]; *Cronwright 60*, Muden [NH, PRE]; *Stirton 12242*, Colenso industrial area [NU]; *MacDevette 2229*, near Colenso [PRE]. Eastern Cape: *Cooper 268*, Queenstown [NH, PRE, TCD]; *Galpin 1584*, Queenstown plains [BOL, GRA, PRE]; *Barber 90*, Queenstown [TCD]; *Flanagan 1509*, near Aliwal North [PRE, SAM]; *Theron 51863*, Winnaarsbaken, Burghersdorp [SAM]. Northern Cape: *Mogg 9066*, Warrenton [SAM]. **Swaziland:** *Miller 3061*, Mbabane [PRE].

5. *Aidomene brevipes* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Schlechter 3516*, South Africa, Gauteng province, Heidelberg [Holo. B† Iso. BOL].

Gomphocarpus brevipes Schltr., in Engl., Bot. Jahrb. 20(5). Beibl. 51: 28 [1895]. **Type:** As above.

Asclepias brevipes (Schltr.) Schltr., in J. Bot., Lond. 34: 455 [1896]. **Type:** As above.

Discussion: Although similar to *A. stellifera* it differs from this species in its less branched nature, smaller stature leaves and flowers and differently colored flowesr (reddish brown in *A. brevipes* and lilac or mauve in *A. stellifera*) (fig. 30). It differs from *A. meyeriana* in being larger and very much less branched (usually solitary). N.E. Brown (1908) tentitively suggested that this species may be of hybrid origin produced by *A. stellifera* and *A. meyeriana*, but we could find no evidence to support this (figs. 38 & 40). In fact, *A. brevipes* has a number of unique characters not found in either suspected parent. There is, however, some indication in pressed specimens that *A. brevipes* does (on a very limited scale) hybridize with these two species; see under *A. stellifera* (fig 39). Some specimens from the Isaac Stegmann nature Reserve (cited below) can have up to 8 stems per plant and may represent hybrids between *A. brevipes* and *A. meyeriana*. These specimens can immediately be recognized as *A. brevipes* by their longer stems and lax demeanor. This species is found in annually burned veld, being particularly found on rocky hillsides such as quartzite ridges and greiss outcrops. It is said to be rare, scattered and inconspicuous. Plants flower from September to december, and occur at altitudes of between 1200 and 1600 meters.

Distribution: South African endemic [Northern, North-West, Gauteng, Mpumalanga and Free State provinces] (fig 35).

Conservation Status: Vunerable to threatened in the vacinity of Johannesburg, Pretoria and Vereeniging; the Vaal Triangle.

Representative Specimens: South Africa: Northern: *Meeuse 9346a*, near Palala heights [PRE]; *Acocks & Hafström 1112*, near Nylstroom [PRE - with stem-tuber]. North West: *Ubbink 1385*, Potchefstroom [PRE]; *Moss 13519*, between Nancefield & Midway [J].

Figure 29. *Aidomene meyeriana*: a. & b. Whole plant showing habit (50 to 100mm tall); c. Close up of flowers. *A. brevipes*: d. Flowering stem. Photographs: a to c by A. Nicholas; d by van Wyk & Malan.

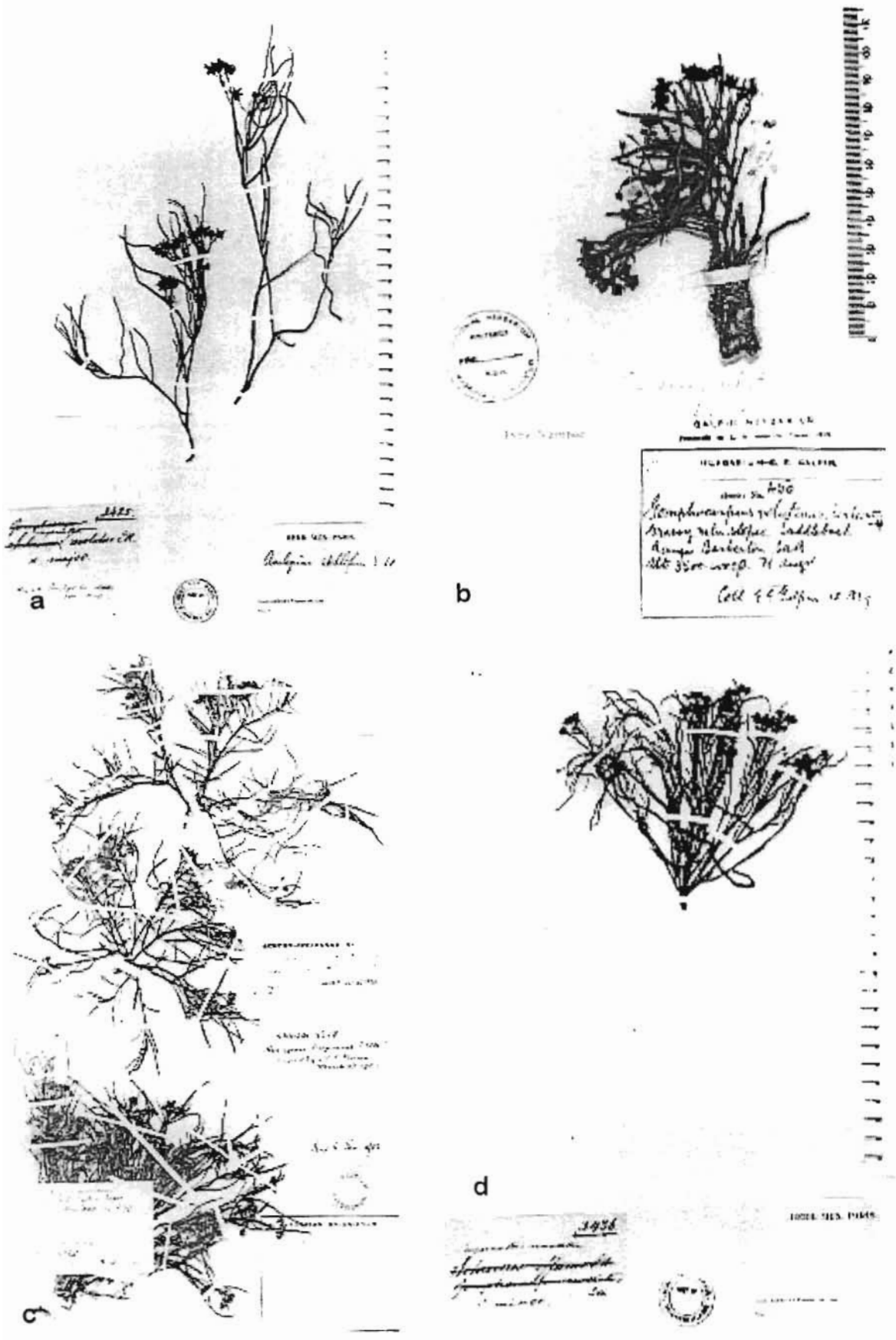


Figure 31. *Aidomene revoluta*: a. Isotype, Drege 3425 (P). b. *A. velutina*: Isosyntype: Galpin 450 (PRE). *A. meyeriana*: c. Isotype, Schlechter 3378 (BOL); Isotype of *Lagarinthus revolutus* var. *minor* [= *A. meyeriana*] (P).

Gauteng: *Clarke 1648*, Menlo Park [PRE]; *Lucas 78*, Melville Koppies [J]; *Leendertz 295*, Pretoria [GRA, SAM]; *Moss 13519*, between Nancefield & Midway [J]; *Moss 7978*, Witpootjie Kloof [J]; *Repton 3088*, Rietvlei Reserve [PRE]; *Raal 68*, Frankenwald [J]; *Prosser 1295*, Observatory Golf Course [NBG]; *Cain s.n.*, Melville Kopies [J 37933 flowers & fruits]; *Moss 13514*, Magaliesburg [J]; *Behr 581*, Roodepoort Botaniv Gardens [PRE]. Mpumalanga: *Rogers 2514*, Witbank [PRE]. Free State: *Goossens 491*, near Heilbron [PRE].

Possible hybrids between *A. brevipes* & *A. meyeriana*

Gauteng: *Mogg 34951*, Isaac Stegmann Nature Reserve [J]; *Mogg 36252*, Isaac Stegmann Nature Reserve [J]; *Mogg 34538*, Isaac Stegmann Nature Reserve [J].

6. *Aidomene cucullata* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 1034*, South Africa, Mpumalanga province, Saddleback near Barberton [Holo. B† Iso. K, PRE].

Gomphocarpus cucullatus Schltr., in Engl., Bot. Jahrb. 18(5). Beibl. 45: 17 [1894]. **Type:** As above.

Asclepias cucullata (Schltr.) Schltr., J. Bot., Lond. 34: 455 [1896]. **Type:** As above.

Trachycalymma cucullatum (Schltr.) Bullock, Kew Bull. 1953: 620 [1955]. **Type:** As above.

Discussion: This is the only species of subgenus *Astrocalymma* that has a cucullate rather than slipper-shaped corona-lobe (fig. 33). This species grows in open, annually burned midland or highland grassveld. Plants are often found amongst stones and was common in road reserves before grazing by cattle was allowed in these once species rich areas. They flower from September to December, and occur at altitudes of between 1000 and 2400 meters. The Zulu call this plant *udambisa* or *udelenia* and use an infusion of the stem-tuber as a sprinkling charm against evil (Hulme, 1954). It is also inhaled as a treatment for confusion or rubbed into shallow cuts on the skin surface to alleviate abdominal pain (Hutchings 1996).

This species is widespread up the eastern side of the subcontinent and is especially common in KwaZulu-Natal (fig. 35). In southern Africa the vegetative

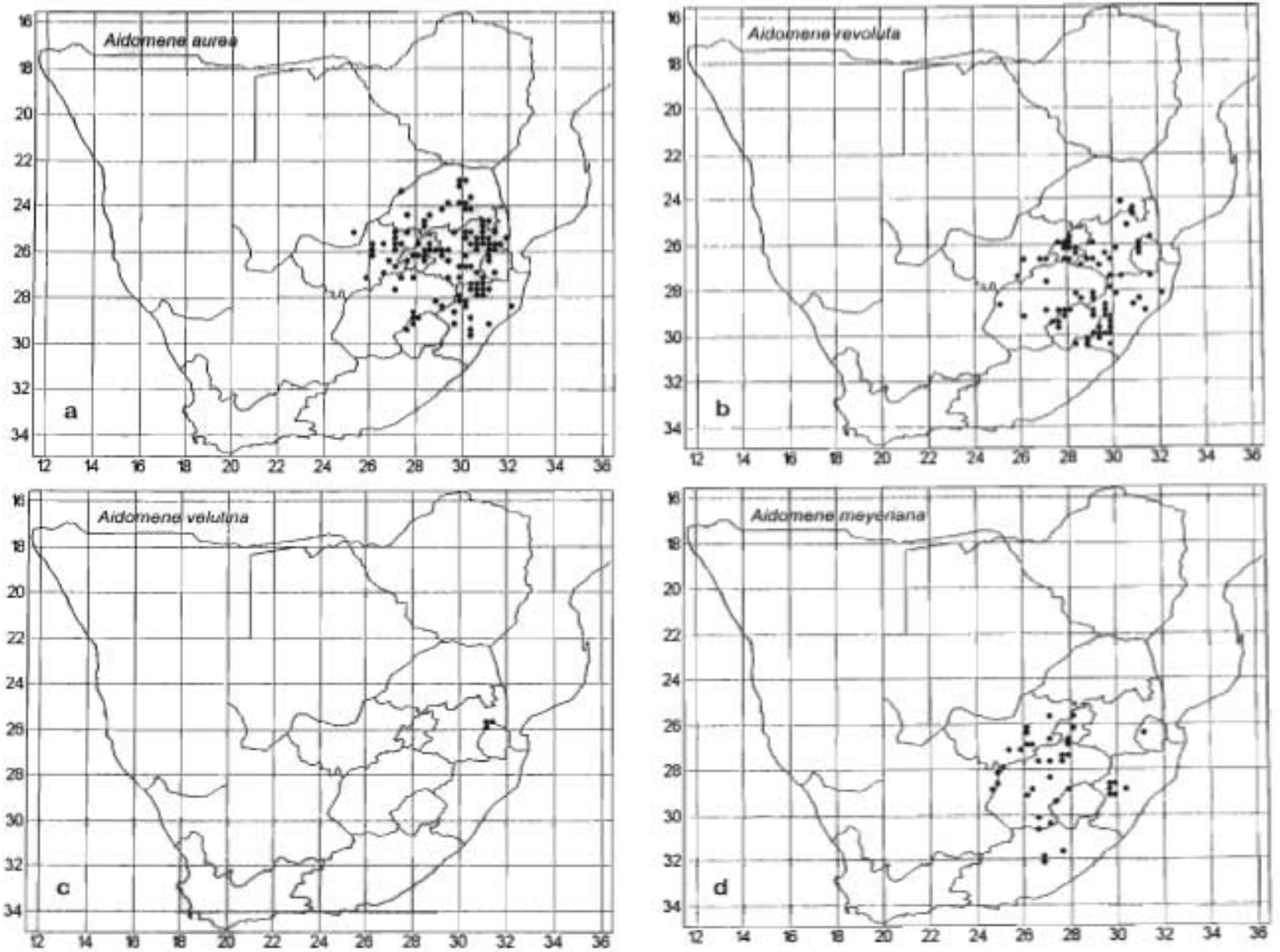


Figure 32. Distribution maps of: a. *Aidomene aurea*; b. *A. revoluta*; c. *A. velutina* and; d. *A. meyeriana*.

morphology can vary greatly, however, the coronal mrophology is constant. Three specimens collected in the Northern Province form a distinct ecotype in having more stems, more flowers and shorter peduncles and petals. Specimens we have examined from Mozambique (*Taylor 1785* [NU] & *Tôrre 6241A* [PRE]) and Zimbabwe (*Obermeyer 2116* [PRE]) differ considerably from the southern African material (with shorter leaves, peduncles and petals, differently sized and shaped corona-lobes, and differently coloured flowers) and we have not included them in this species as defined here. For these same reasons we have not been able to uphold Bullocks inclusion of *Asclepias pygmaea* under *A. cucullata*.

Distribution: Southern African endemic. Found in Lesotho, South Africa [Northern, Mpumalanga Free State, KwaZulu-Natal and Eastern Cape provinces] and Swaziland (fig. 35).

Conservation Status: Not yet of concern, although vunerable in some areas.

Representative Specimens: South Africa: Northern: *Venter 7168*, The Down farm [PRE]; *Acocks & Hafström 1114*, Pietersburg commonage [PRE], Leendertz 826, Frischgewacht, Zoutpansberg [GRA, K, PRE]; *van Vuuren 1821*, Pietersburg commonage [PRE]; *Jacobsen 3450*, Kransberg, Highfield [PRE]; *Venter 1185*, Metz Mission [PRE]. Mpumalanga: *Kerfoot K8068*, Mt. Sheba Nature Reserve [J]; *Pott 4651*, Haenertsburg [GRA, PRE]; *Meeuse 10266*, Kemp's Heights [PRE]; *Pott 14928*, Spitskop [PRE]; Burgoyne 562, Groot Suikerboskop farm, Dullstroom [PRE]; *Pole-Evans 13167*, Carolina, Everand's farm [K, PRE]; *Codd & de Winter 3133*, near Machadodorp [PRE]. Free State: *Roux 839*, Seheletwane [NBG]; *van der Zeyde s.n.*, Harrismith [NBG]. KwaZulu-Natal: *van Wyk 7603*, Ngeli Mountain [PRE]; *Nicholas 927*, near Underberg [CPF, K, MO, NH, NU]; *Nicholas 929*, near Himeville [NH, NU]; *Nicholas 931*, Garden Castle [NH, NU]; *Nicholas 934*, near Bushman's Nek hotel [CPF, MO, NH, NU]; *Nicholas 936*, near Bulwer [NH, NU]; *Nicholas 961*, Giant's Castle Game Reserve [CPF, K, NH, NU]; *Nicholas 969*, Tabamhlope [CPF, K, MO, NU]; *Nicholas 971*, near White Mountain Inn [NU]; *Nicholas 1013*, Karkloof, Shawood farm [CPF, MO, NH, NU], *Nicholas 1039 with George*, Dargle, Killikeen farm [NU]; *Nicholas 1114*, Cathedral Peak Forest Station [CPF, PRE]; *Nicholas 1135 with Norris*, Nkonzo State Forest [CPF]; *Nicholas 1157 with Norris*, Ngonigoni mountain [CPF, MO, NH, PRE]; *Nicholas 1227*,

Figure 33 . *Aidomene cucullata*: a. Whole plant showing habit & habitat (200mm tall); b. Whole plant showing narrow cylindrical stem-tuber marked with an arrow; c. & d. Inflorescences showing different colored flowers (yellowing is often associated with old flowers & act as a signal to pollinators to inform them that nectar is no longer available); e. Close up of flowers. Photographs: a, b, f & g by A. Nicholas; c by M. von Fintel & d by T. de Waal.

Monks Cowl State Forest [CPF]; *Nicholas 1683*, Weza State Forest [NH]; *Wood 4820*, van Reenen [NH, PRE]; *Wood 5667*, van Reenens pass [PRE, SAM]; *du Toit 2518*, Nyiginye [NH, PRE]; *Hutton 347*, Howick [GRA, K]; *Nicholas 2747 with Poorun*, Sani Pass [UDW]; *Nicholas 2752 with Poorun & Govender*, Giant's Castle [UDW]; *Nicholas 2756 & 2758 with Poorun & Govender*, Kamberg [UDW]; *Nicholas 2765 with Poorun & Govender*, Loteni [UDW]; *Nicholas 2842*, Sani Pass [UDW]; *MacDevette 1090*, Swartkop [NH]; *Ruddock 66*, Highmoor State Forest [NU]; *Balkwill, Manning & Cadman*, Cobham State Forest [NU]; *MacDevette 2030*, Cobham State Forest [PRE]; *Schrire 1339*, near Utrecht [NH]; *Hilliard & Burtt 17052*, Mulangane ridge, Carter's Nek [NU fruits]; *Hillard & Burtt 13276*, near Underberg on Swartberg road [NU]. Eastern Cape: *A & G Hutchings 1836 with Plumstead*, Mhlahlane Forestry Reserve [KEI]; *A & G Hutchings 1778*, Baziya Forest [KEI]; *Payne 32*, Tsolo, St. Cathberts [GRA]; *Baur 305*, Baziya [K, SAM]; *Bester 1708*, Maclear, farm Cromarty [NH]; *Bester 1652*, Maclear commonage [NH]; *Abbott 6117*, Nsikeni [NH]. **Swaziland:** *Compton 24548*, Ukutula [NBG]; *Compton 28183*, Black Mbulusi falls [NH, NBG, PRE]; *Miller 3062*, Haveloch mine [PRE]; *Compton 29174*, near Mankaiana [NBG]; *Dlamini s.n.*, Dalriach [PRE 31220[; *Dlamini s.n.*, Poliniane [PRE 31221]; *Karsten s.n.*, Palwane [PRE 31222]. **Mozambique:** *Grosvenor 198*, between Skeleton Pass & the Plateau [PRE]. **Zimbabwe:** *Nyariri 385*, Nyamunyeche Estate, Great Dyke [PRE]; *Wild 1522*, Inyanga [PRE].

AIDOMENE* Stopp *Subgenus CALLOCYMBION* Nicholas & Goyder. *Subgen. nov. ***Caule*** *1—2, 50—230mm longi.* ***Folia*** *linearia, lanceolata vel oblonga, 8—92mm longa, 1.2—18mm lata.* ***Inflorescentia*** *terminalis vel et extra-axillaris, cum bracteis persistentibus, pedunculo 12—25mm longo.* ***Flores*** *ut videtur stellaeformes.* ***Corolla*** *patens, apicibus curvato-erectis, intus lilacina vel alba, eburnea purpureo-tineta, nervibus atropurpureis, extus alba, cremea vel fusco-brunnea, purpureo-, violaceo- vel roseo-maculata.* ***Coronae lobi*** *cucullati complicati et naviculares vel calceiformes, sinu cavitate centrali saccata.* ***Gynoecii*** *apex applanatus, ad centrum depressus.* **TYPUS:** *Aidomene oreophila* (Nicholas) Nicholas & Goyder, *vide infra.*

Description: *Rootstock* a solitary narrow fleshy cylindrical deep-seated stem-tuber, 2.5—9.0mm wide. *Stems* 1—2, 50—230mm long, unbranched, erect. *Leaves* equally spaced along the stem or concentrated towards the stem base; lobes linear, lanceolate to oblong, 8—92mm long, 1.2—18.0mm wide, coriaceous with only mid rib below prominent & margins slightly revolute or soft & herbaceous with midrib & 2° veins prominent & margins smooth; petiolate sessile or up to 13.5mm long. *Inflorescences* 1—4 per plant, 1—3 per stem, terminal or terminal & laterally, extra-axillary at the nodes, 4-flowered, rarely 5; bracts persistent, linear-subulate to triangular, 3.5—8.5mm long; peduncles 12—25mm long. *Flowers* stellate, 13—23mm wide; pedicel 5—19mm long. *Corolla* spreading with apices curved erect (viz. rotate campanulate), 7.8—11.5mm long, 4.5—7.0mm wide, color inside lilac to white, or ivory tinted purple, veins dark purple, outside white to cream or gray-brown, with many large to small purple, violet or pink spots (*A. oreophila*), abaxial surface dark purple, adaxial surface white, abaxial surface puberulous to pubescent with hairs concentrated near the apex. *Staminal-corona* arising 1mm above the gynostegial-column base; lobes spreading, complicate-cucullate & naviculiform to slipper-shaped, sinus a central sac-like cavity, 3.2—8.5mm long, 2.0—5.0mm high, in *A. oreophila* the upper proximal ends forming 2 triangular appendages that are reflexed back towards the distal end. *Staminal-column* 3.4—5.0mm tall; anther-appendages ovate to reniform. *Style-apex* truncated & depressed in the middle.

Discussion: This interesting subgenus has only two species. Although similar to the type subgenus in corona-lobe structure *Callocymbion* differs significantly in its overall floral facie. The size of the flowers and its unusual color, vegetative vestiture & petal merotaxy (which is cup-like) are different. The flowers are quite beautiful, hence the name *Callocymbion*, which is Greek in origin and means beautiful (*callo*) cup (*cymbion*). A serendipitous encounter with these plants in the field always draws ones attention; as does the monotypic genus *Fanninia* which shares many features with *Callocymbion* and also very probably had a common origin with it. However, we have not lumped these two taxa together because the corona-lobe of *Fanninia* (being laminar and linear-oblong in shape, erect but geniculate and two toothed at the base, and with no sinus) is so different. This plus a few other characters immediately prevent these being treated as congeneric. Also, *A. humilis* bears some resemblence to certain species in *Schizoglossum*, while *A.*

oreophila bears some relationship to species of *Pachycarpus* section *campanulati*; this is discussed in more detail under *A. humilis* and *A. oreophila*.

Distribution: South African endemic [Eastern Cape and KwaZulu-Natal provinces].

Key to species:

1a. Corona-lobes 6.0—8.5mm long. Anther-appendages reniform to rounded. Leaves crowded towards the base of the stem ..... *A. humilis*

1b. Corona-lobes 3.2—4.5mm long. Anther-appendages ovate. Leaves not crowded towards the base of the stem ..... *A. oreophila*

7. ***Aidomene humilis*** (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Type:** *Drége 3240*, South Africa, Eastern Cape province, Witteberg near Aliwal North [Holo. B† Iso. P. *fide* Decasine 1844].

Pachycarpus humilis E. Mey., Comm. Pl. Afr. Austr. 212 [1838]. **Type:** As above.

Xysmalobium humile (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above.

Gomphocarpus humilis (E. Mey.) Decne., in DC., Prodr. 8: 561 [1864]. **Type:** As above.

Asclepias humilis (E. Mey.) Schltr., in Engl., Bot., Jahrb. 20(5). Beibl.51: 26 [1895]. **Type:** As above.

Discussion: This species differs from *A. oreophila* in having the leaves clustered towards the stem base and spreading erect. The leaf blade is oblong and 4.5 to 18mm wide, the apex is blunt, the midrib and secondary veins are prominent and the texture is softly herbaceous with margins smooth. Petioles range from 2 to 13.5mm in length. Peduncles are 12 to 25mm long. Flowers are mauve or reddy-mauve. Petals are 4.5 to 5.5mm wide. Corona-lobes are slipper-shaped and simple, 6.5 to 8.5mm long and 5mm tall, with sinus 2mm deep. Anther appendages are reniform. The corona-lobe of this species is so like that of subgenus *Astrocalymma* that a case could be made for including it in that taxon, however, it differs in almost all other features (fig. 34).

As long ago as 1895 Schlechter pointed out that in its vegetative facies and some of its floral features, *A. humilis* resembles the monotypic *Fanninia*. *Fanninia* differs in having an erect, ligulate sinusless corona rather than one that is slipper-like with a sinus. It also has erect oblong petals that form a cage around the gynostegial-column. The two taxa, however, probably had a distant common origin. *A. humilis* also bears a great similarity to the following *Schizoglossum* species: *S. elingue*, *S. flavum* and *S. stenoglossum*. These similarities cover so many different structures from habit to leaf type and texture, to pollinia shape. As a result, they suggest a phylogentic relationship and indicate that these species of *Schizoglossum*, at least, had a common origin with *Aidomene* subgenus *callocymbion*. This would suggest that *Schizoglossum* may not be monophyletic or that *A. humilis* is the product of a hybrid event.

A. humilis may be found growing in open (usually annually burned) highland or mountain grassveld (fig. 33). Plants flower from October to January (peaking in December) and are found at altitudes of between 1800 and 2900 meters. Populations are usually found at very high altitudes and may be either scattered or occasionally growing in mass. The stem-tuber is apparently eaten (Guillarmod, 1971).

Distribution: Southern African endemic. Lesotho and South Africa [Free State, KwaZulu-Natal & Eastern Cape provinces] (fig. 35).

Conservation Status: Not threatened in the short term, vunerable in the long term

Representative Specimens: Lesotho: *Coetzee 509*, Meniameng Pass [BLFU, PRE]; *Jacot-Guillarmod 210*, Lehaha la Sekhonyana [PRE]; *Compton 21299*, Mamalapi [PRE]; *Compton 21299*, Mamalapi [NBG]; *Schmitz 9166*, Blue Mountain pass [PRE]; *Mzamane 105*, Malibamatso Valley [PRE]; *Jacot Guillarmod 121*, Little Bokang [PRE]; *Lubke 257*, Butha Buthe [PRE]; *Compton 21299*, Mamalapi [PRE]; *Killick 4143*, Sani Pass Summit [PRE good rootstock]; *Hoener 1887*, Sehlabathebe National Park [PRE]; 8499, Bushman's Pass [PRE]; *Panagos 133*, Maluti Mountains [PRE]. **South Africa:** Free State: *Flanagan 2066*, Mont aux Sources [BOL, NH, PRE]; *Flanagan 8117*, Mont aux Sources [GRA]; *Roux 1085*, Sentinel [NBG]; *Thode 6354*, Caledon Ridge [STE]. KwaZulu-Natal: *Nicholas 2070 with Priday & Keet*, Highmoor State Forest [NH]; *Nicholas 2759 with Poorun & Govender*, Kamberg [UDW]; *Killick 1633*, Cathedral Peak Forest Reserve [PRE]; *Balkwill & Manning 760*, Monks Cowl Forest Reserve [NU];

Hilliard & Burtt 15508, Sani Pass [NU fruit]; *Hilliard & Burtt 11734*, Storm Heights [NU]; *Hilliard & Burtt 9652*, Sani escarpment [NU]; *Trauseld. 704*, Giant's Castle Game Reserve [NU]; *Trauseld 465*, Giants Castle Game Reserve [PRE]; *Hilliard & Burtt 16984*, Mulanagane Ridge, Carter's Nek [PRE]. Eastern Cape: *A & G Hutchings 1882*, Ongeluk's Nek [KEI, PRE]; *Dold 3468 with Cocks*, Tiffendell Ski Resort near Rhodes [GRA]; *Phillipson 606*, Mfecani Pass [PRE, UHF]; *Boardman 185*, Ramatselitsos Gate [PRE]; *Matthews 815*, Ben MacDhui [NBG]; *Marloth 11417*, Great Winterberg [PRE]; *Ford s.n.*, Great Winterberg, Adelaide district [PRE not typical].

8. *Aidomene oreophila* (Nicholas) Nicholas & Goyder. *Comb. nov.* **Type:** *Hilliard & Burtt 11703*, South Africa, KwaZulu-Natal province, Mpendhle, Kamberg area, Storm Heights. [Holo. NU, Iso. E, PRE].

Asclepias oreophila Nicholas, in Hilliard & Burtt, Notes Royal Botanic Gardens Edinburgh 43(2): 192—193 [1986]. **Type:** As above.

Discussion: This species differs from *A. humilis* in having the leaves scattered along the erect stem. The leaf blade is linear to lanceolate and 1.2 to 7.0mm wide, the apex is acute, only the midrib is prominent and the texture is almost coriaceous with the margins revolute. Leaves are apetiolate or up to 4mm long. Peduncles are 16 to 54mm long. Flowers are greenish purple-gray to creamy pink. Petals are 5.5 to 7.0mm wide. Corona-lobes are naviculate and complex (with the proximal appendages more or less blocking the sinus openning), and 3.2 to 4.5mm long, 2.0 to 3.5mm tall with sinus 2.0 to 3.5mm deep. Anther appendages are ovate (fig. 34).

As already mentioned, and like *A. humilis*, this species resembles *Fanninia caloglossa*. It differs vegetatively having narrower more coriaceous leaves and quite different corona-lobes. *A. oreophila* also resembles species of *Pachycarpus* section *campanulati*. The leaves of both are similar, as is flower color and structure especially the anther-wings (which are noticeably beaked and concave basally). Also the corona-lobes, although they seem very different, are not. A reduction in sinus depth will lead to the ligulate situation, with small basal proximal appendages or wings, as is found in both *Pachycarpus* section *campanulati* and *Fanninia*. *A. oreophila* also bears a resemblence to

Figure 34. *Aidomene oreophila*: a. Inflorescence. *A. humilis*: b. Whole plant showing habit & habitat (200mm tall); c. Close up of flowers; d. Flower with visiting butterfly. e. Panorama at Giant's Castle in the Natal Drakensberg, typical of the high altitude montane grasslands in which both these species occur. Photographs: a by J. Stewart; b, d & e by A. Nicholas and; c by M. von Fintel.

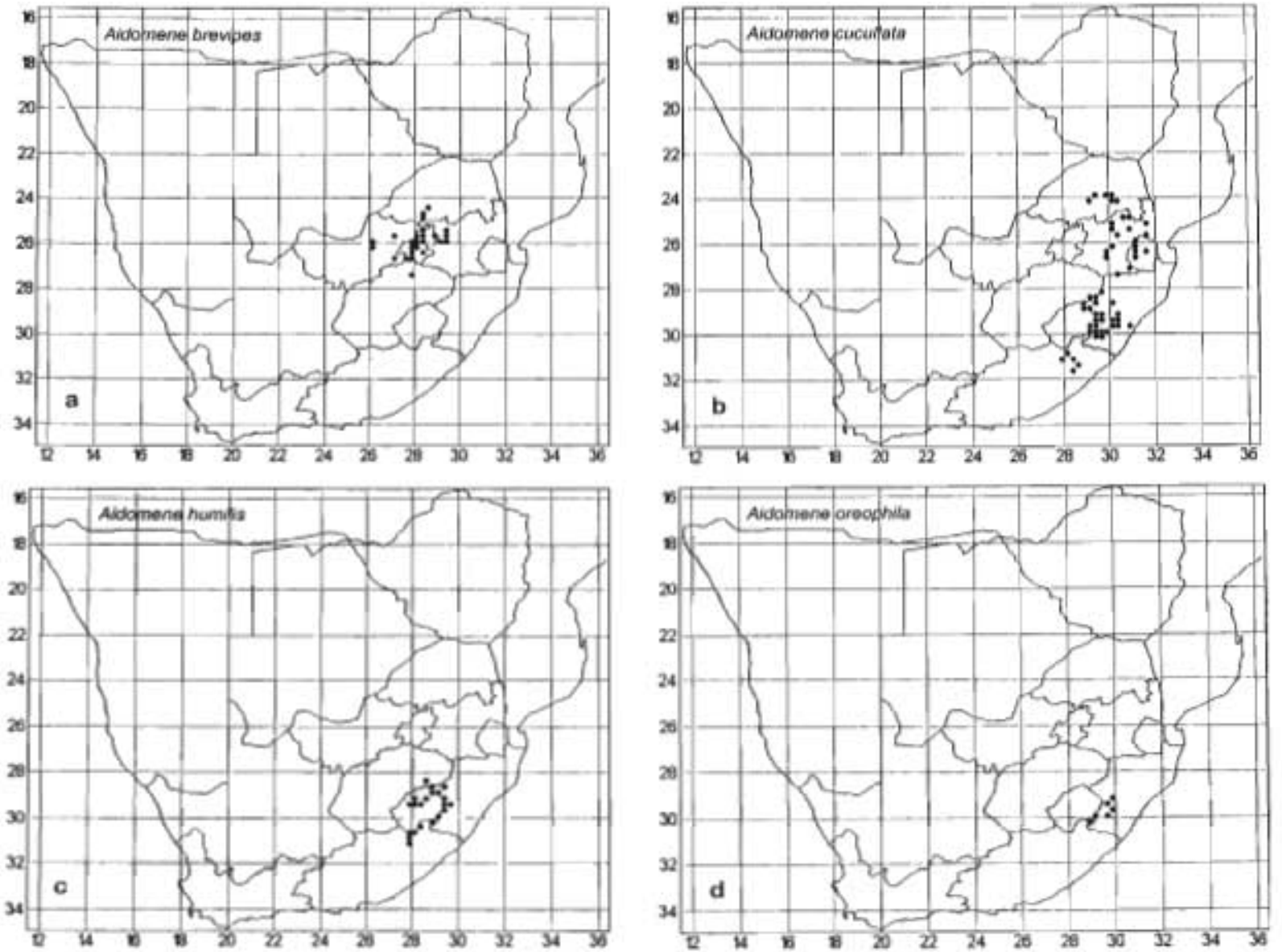


Figure 35. Distribution maps of: a. *Aidomene brevipes*; b. *A. cucullata*; c. *A. humilis* and; d. *A. oreophila*.

some species of *Trachycalymma*, which this species was originally mistaken for. As already discussed, *Aidomene* as a whole may have had a common origin with *Trachycalymma* thus accounting for similarities seen in *A. oreophila*.

A. oreophila may be found growing in short, burned or unburned, mountain grasslands, occuring at very high altitudes (fig. 34). Plants are rare and no new material has been collected since this species was first named in 1986. Plants flower from November to January and occur at altitudes between 1700 to 3000 meters. Like *A. humilis*, this species is found on the Drakensberg.

Distribution: Southern african endemic. Found in Lesotho and South Africa [Eastern Cape and KwaZulu-Natal provinces] (fig. 35).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Although mot often collected, this species is largely protected by its high altitude distribution.

Representative Specimens: Lesotho: *Bayliss 7901*, near Ramas Gate [PRE]; *L & R Davis 193*, Bushman's Nek pass [NU]. **South Africa:** KwaZulu-Natal: *Killick & Vahrmeijer 3579*, Highmoor State Forest [PRE]; *du Toit 2495*, Highmoor State Forest [NH]; *Stewart 2083*, Vergelegen Nature Reserve [NU]; *Hilliard & Burtt 11245*, Kamberg, Allendale farm [NU]; *Manning, Hilliard & Burtt 15984*, Cobham State Forest Reserve [NU]; *Hilliard & Burtt 14931*, Garden Castle Forest Reserve [NU]; *Killick & Vahrmeijer 3981*, Bushman's Nek [PRE]; *Hilliard & Burtt 17173*, Gxalingenwa valley [NU]; *Wright 1323*, Redruth, Impendhle [NU]. Eastern Cape: *Boardman 184*, near Ramatseliso's Gate [PRE].

AIDOMENE* Stopp Subgenus *SCYPHOCALYMMA* Nicholas & Goyder. *Subgen. nov.* *Caule* *1—4, breves, circa 110mm longi.* *Folia* *linearia, brevia, 16—68mm longa.* *Flores* *non ut videtur stelliformes.* *Coronae lobi* *cyathiformes, elatus quam latus aut excelsus quam latus, sinu sacciformis, glandulifera.* *Antherae appendices* *reniformes, apice vadose fissae, latiores longis.* *Gynoecii* *apex sub-conicus undulatus.* TYPUS: *Sigridia nana* (Verdoorn) Nicholas & Goyder, *vide infra.

Description: *Stems* 1—4, short ±110mm long, unbranched, laterally flattened. *Leaves* equally spaced along the stem; lamina linear, short 16—68mm long, apex acute to

pungent, base tapering, margins revolute, venation not pronounced except for the large, lighter colored midrib; petiole sessile or up to 1mm long. *Inflorescences*: about 12 per plant, 1—6 per stem, terminal & lateral, extra-axillary at the nodes, 4-flowered; peduncles 5—8mm long; bracts caducous, linear-triangular, 2.5mm long, 0.3mm wide. *Flowers* rotate but not stelliferous, 5—8mm high, 9—11mm wide, lilac; pedicels 6—9mm long. *Sepals* lanceolate, 2.7—3.0mm long, 1.0—1.3mm wide, apex acuminate. *Corolla* spreading to reflexed; lobes lanceolate, ovate to elliptic, 5.4—6.0mm long, 3—4mm wide, apex acute. *Staminal-corona* arising 0.5 to 1.0mm above the gynostegial-column base; lobes cyathiform, erect, as tall as wide or taller than wide, 1.0—2.2mm wide, 2.3—2.8mm wide; upper proximal margin forming 2 dentate or arm-like appendages which are level with the style-apex, upper distal end obtuse, never raised above the style-apex; keel truncate, with triangular ridge of tissue near base this eventually becomes a transverse ridge or shallow marsupium that acts as a guide-rail during pollination & which runs along either side of the lobe near its base, sinus sac-like, 1.0—2.2mm deep, glanduliferous (but never papillate). *Staminal-column* 3—4mm tall; anther-wings beak-like, base concave & beak-like, outer margin obliquely slanted & very slightly concave, ±1mm long, 0.6—0.7mm wide; anther-appendages reniform, 0.3—1.2mm long, 0.5—2.1(-3.5)mm wide, shallowly cleft at the apex, decumbent on style-apex side. *Pollinaria*: Pollinia hemipyriform to clavate. *Style-apex:* Conical & swollen-undulate above corpusculum attachment, 1.7—2.2mm in diameter.

Distribution: South African endemic. Restricted to the semi-arid regions in the Northern and North West provinces.

Discussion: Its non-stelliferous flowers makes this taxon seem abberrant in the genus *Aidomene*, however, given its overall structure subgenus *Scyphocalymma* seems to be related to this genus and may have had a common origin from them rather than with them. Verdoorn (1924) mentions the possible alliance of *A. nana* to *A. cucullata* (with which we concur), however, this relationship, as already mentioned, is quite distant. Although a case could be made to place these two species in a genus of their own we have rather opted for including them in *Aidomene* even though it makes the circumscription of this genus less uniform. This is a dilemma common to all taxonomy, for although we may aim for some structural uniformity in groups, evolutionary end

products are not necessarily morphologically uniform. Forces of adaptation working on populations spread over a wide variety of mosque environments will, in all liklihood, produce different evolutionary outcomes. If classifications are to be based on phylogeny (which they must be if they are to be informative, predictive and heuristic) morphological uniformity has to be sacrificed. In such cases single, often homoplasious, characters cannot be used to define monophyletic groups. As a result, correlated set of characters have to be used instead. Unfortunately, phylogenetic classifications because they are based on a complex pattern of relationship, defined by many correlated characters (rather than just one character), are more difficult to work with (keys more difficult to compile and groups needing more time and insight to comprehend), but such classifications are infinitely more useful than artificial classifications. **Etymology**: The name *Scyphocalymma* is Greek in origin and refers to the cup-like structure of the corona-lobes: *Scypho* meaning cup and *calymma* meaning head-covering or hood. Both species in this subgenus are rare and restricted endemics; known from only one collection each. Plants are small in stature being about 100mm in height and plants are somewhat xeromorphic in structure.

Key to Species:

1a. Corona-lobes with the distal end lower than the small, erect, dentate proximal appendages ..... *A. nana*

1b. Corona-lobes with the distal end level with the blunt arm-like proximal appendages, which are reflexed back into the corona sinus ..... *A. hespera*

9. *Aidomene nana* (Verdoorn) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 8148*, South Africa, Northern province, Pyramid Estate near Potgietersrus [Holo. PRE. Iso. K] (fig. 36).

Asclepias nana Verdoorn, in Kew Bull.: 254 [1924]. **Type:** As above.

Discussion: Verdoorn (1924) points out this species similarity to *Asclepias cucullata* (= *Aidomene cucullata*) and *Asclepias brevicuspis* (= *Bruynsia brevicuspis*). The relationship with *A. cucullata* may be real as *A. nana* resembles this species in its leaf

structure and some of its floral morphology (viz. inflorescence, petals, staminal-column and to a degree corona-lobes). *Bruynsia brevicuspis*, however, is quite different especially in leaf structure, inflorescence, corona-lobes, anther-wings (with its distinct medial notch) and pollinaria. The specific epithet *nana* refers to the small size of this plant. This rare grassland species flowers in about October and occurs at about 1360 meters.

Distribution: South African endemic [Northern province only] (fig. 36).

Conservation Status: This plant is only known from one collection (the holotype) made near Potgietersrus over 75 years ago. The fact that it has not been collected recently indicates that this plant is both rare and of restricted distribution. Although large sections of the Northern province are undisturbed, much of it is nonetheless heavily grazed or under agriculture; especially the granite plains where *A. nana* is found. For these reasons this species should be considered endangered, if not extinct.

10. *Sigridia hespera* Nicholas & Goyder. *Sp. nov. S. nanoti.* ***Caulis*** *unicus, erectus vel effusus.* ***Folia*** *ascendentia vel patentia, linearia, 16—68mm longa, 0.6—2.0mm lata, apice acuminata, basin cuneata, margine revoluta; apetiolata.* ***Inflorescentia*** *umbelliformis, terminales et extra-axillares, bracteis probabiliter caducis; pedunculis 5—8mm longis.* ***Flores*** *4 in inflorescentia, circa 5mm longi, circa 9mm longus; pedicellis 7—9mm longis.* ***Corolla*** *patens, petalis lanceolatis ad anguste ellipticis, circa 5.4mm longis, circa 3.5mm latis, pagina abaxiali glabrata.* ***Coronae lobi*** *cyathiformes, circa 2.3mm longis, circa 1mm lati. Extremi proximalea superiores marginis appendices duos brachiformes obtuses, circa 0.6mm longes reflexes formantes, gynoecii apicem aequantes. Margo superior integer, concavus, extremo distali obtuso appendices proximales. Carinae crista basin versus parva marsupiata formans; sinu saccato.* ***Androecium****: Antherae appendices reniformes, circa 1.2mm longi, circa 3.5mm lati, gynoecii apicem premens.* ***Gynoecii*** *apex subconicus.* **Typus:** *Gillett 18513*, South Africa, North-West province, Rooikop [Holo. BOL], *vide infra.*

Description: *Underground-organ:* Not seen. *Stems* 1, height unknown (specimen incomplete), erect to spreading, bifariously haired towards the apex. *Leaves* ascending or spreading, linear, 16—68mm long, 0.6—2.0mm wide, apex acuminate almost pungent,

base tapering, margins revolute, venation not pronounced except for the midrib and the adaxial surface; apetiolate. *Inflorescences* umbel-like, terminal & lateral, extra-axillary at the nodes, ±6 per stem, 4-flowered; peduncles 5—8mm long, decreasing in size towards the apex; bracts probably caducous. *Flowers* ±5mm high, ±9mm long; pedicel 7—9mm long. *Calyx*: 5-merous, lobes lanceolate, ±3mm long, ±1mm wide. *Corolla* 5-merous, spreading; lobes lanceolate to narrow-elliptic, ±5.4mm long, ±3.5mm wide, probably lilac with white margin, abaxial surface glabrous, adaxial surface canescent. *Staminal-corona* 5-merous, joining the staminal-tube 0.5—0.8mm above the gynostegial-column base; lobes cyathiform, ±2.3mm long, ±1mm wide, the upper proximal ends forming 2 blunt arm-like appendages ±0.6mm long, these being level with the style-apex & flexed inwards to meet before becoming reflexed towards the distal end of the lobe, proximal margins entire, shallowly concave, curving down to meet the staminal-tube, the upper margin entire, concave, the obtuse distal end level with the proximal appendages, the keel is straight in its upper half, near the base there is a triangular ridge of tissue which extends along the side of the lobe forming 2 small basal ridges of tissue (= pollination guides rails), these curve up-ward & become wing-like at the proximal margin; on the inner sides these wings form 2 shallow pockets or marsupia; sinus sac-like & glanduliferous. *Staminal-column*: ±3mm long; anther-wings shallowly concave & sharply beaked (almost pointed at the base), after which it then curves sharply inwards and upwards, ±1.2mm long, ±0.6mm wide; anther-appendages reniform, shallowly cleft at the apex, ±1.2mm long, ±3.5mm wide, decumbent on the sides of the style-apex. *Pollinarium* solitary & pendulous in each anther-cell; pollinia hemipyriform to clavate, the outer edge strongly rounded near the base, tapering proximally, the inner margin straight; translator-arms twisted, 1—2 geniculate, appearing articulate in the middle; corpusculum narrow-fusiform. *Style-apex* slightly conical, with 5 small mounds on the thickened undulating margin, concave in the center, 1.7—2.2mm wide. *Fruit & Seeds:* Not seen (fig. 37).

Discussion: This species is closely allied to *A. nana* and probably had a common origin with it. They differ mainly in corona-lobe structure. In *A. nana* there are no upper proximal coronal appendages this part of the lobe [rather having small dentate, erect projections], the upper distal end is lower than rather than level with the upper proximal end, the lower keel ridge and side marsupium or guide-rails are noticeably smaller. Other

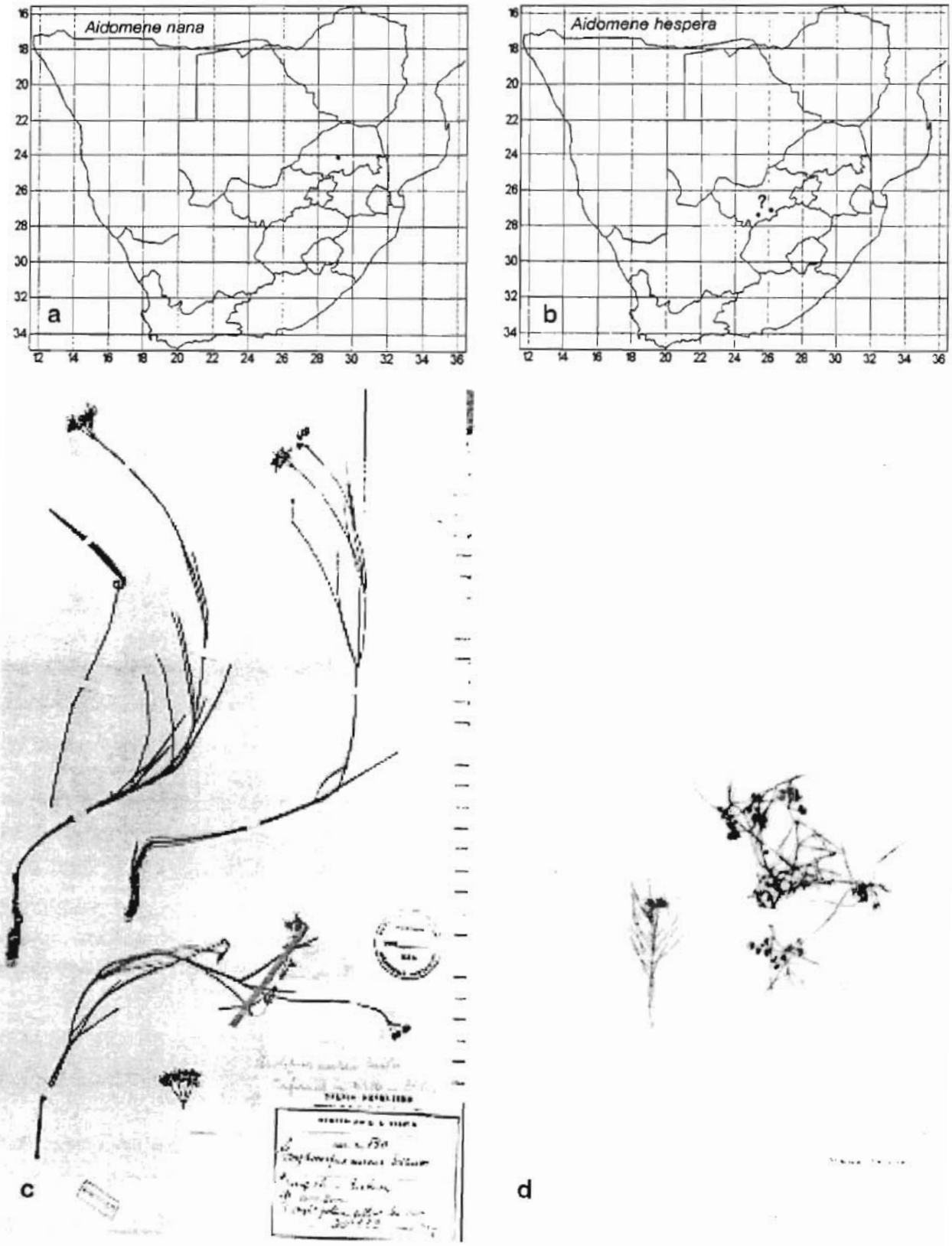


Figure 36. a. Distribution map of *Aidomene nana*; b. Distribution of *A. hespera*. c. *A. aurea*: Isotype Galpin 580 (PRE). d. *A. nana*: Holotype Galpin 8148 (PRE).

differences include longer pedicels, smaller flowers, broader leaves, bigger anther-appendages and longer pollinia.

Unfortunately, two Rooikops exist in the North-West province, one near Odendaalrus and one near Bloemhof, it is unknown at which of these two Rooikops the specimen was collected. This illustrates the need for good detailed specimen labels; unfortunately many collectors forget that a specimen is only as good as the data it carries whether this be label data or a complete specimen. Nicholas (1981) hesitated to give this species a name because there was only one specimen available. However, there is now an urgent need in South Africa to have an inventory of our overexploited phytodiversity. Such information is necessary for proper conservation measures to be implemented, for the establishment of diversity "hot spots" and for various aspects surrounding the biodiversity convention recently ratified by South Africa. As a result, we have decided to name this species here. **Etymology:** The specific epithet *hespera* is from the Greek *hesperos* meaning "western" which, in this case, refers to the distribution of this plant in the west of the country. *Hesperos* also means "of evening" the rarity of this plant and the fact that it may be threatened with extinction makes the name even more appropriate as this species may be in the evening of its existence.

Unfortunately, there was no information concerning habitat on the specimen but, as in the rest of this genus, it is probably found in open grasslands. Plants flower around December and occur at about 1300 meters.

Distribution: South African endemic (North-West province only).

Conservation Status: This rare endemic occurs in a province which verges on being semi-arid and is heavily utilized for agriculture and grazing, it must, therefore, be considered threatened if not extinct.

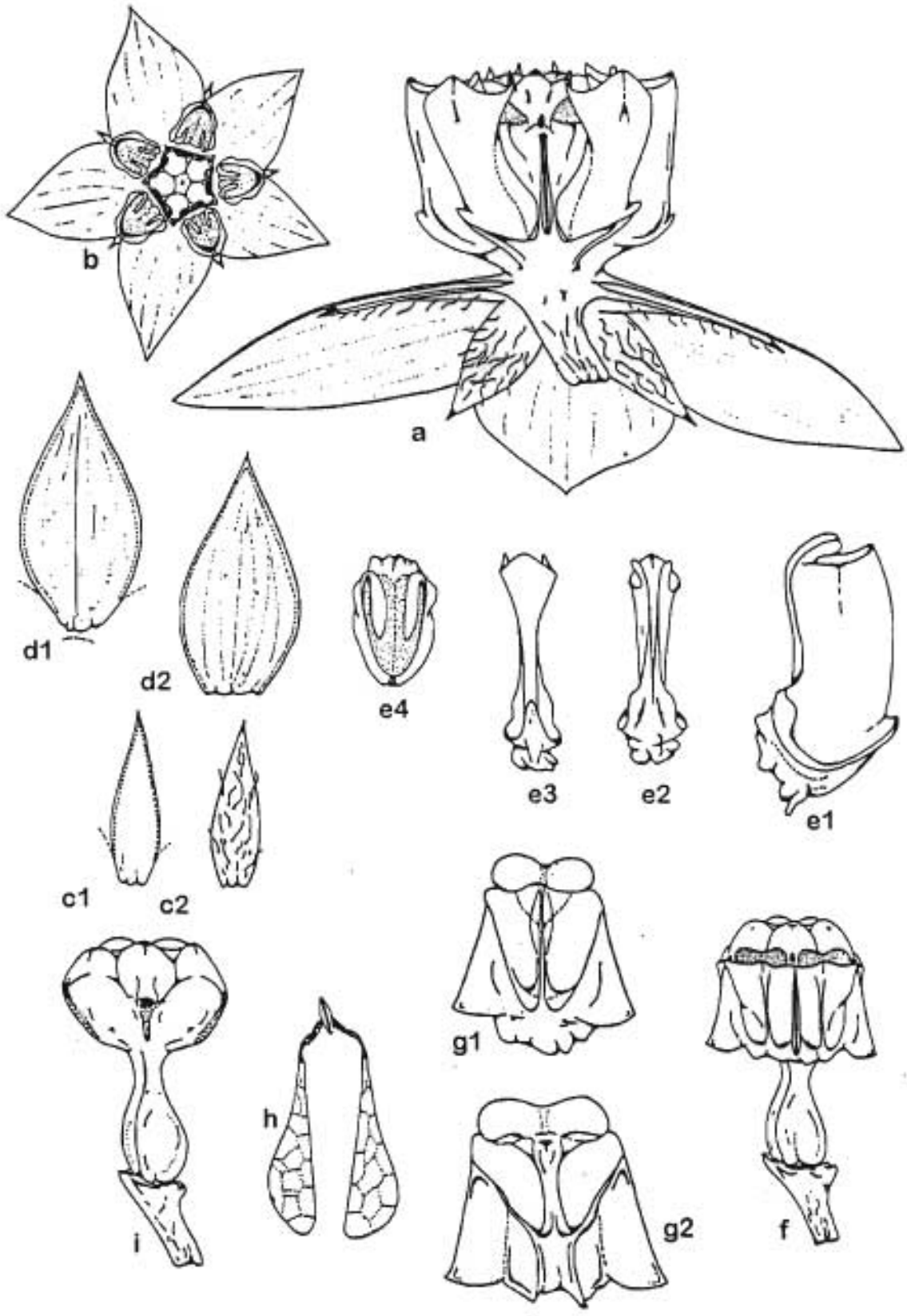


Figure 37. *Aidomene hespera*: a. Whole flower with part of caylx & corolla removed x14; b. Flower from above x6; c. Sepals x15: c1. Adaxial surface, c2. Abaxial surface; d. Petals x15: d1. Adaxial surface, d2. Abaxial surface; e. Corona-lobe x15: e1. Side view, e2. Inner view, e3. Outer view, e4. Top view; f. Gynostegial-column with corona removed (showing staminal curtain) x15; g. Anthers x24: g1. Abaxial surface, g2. Adaxial surface; h. Pollinarium x40; i Gynoecium (showing apocarpous carpels & style-stigma-head) x15. Drawings by A. Nicholas.

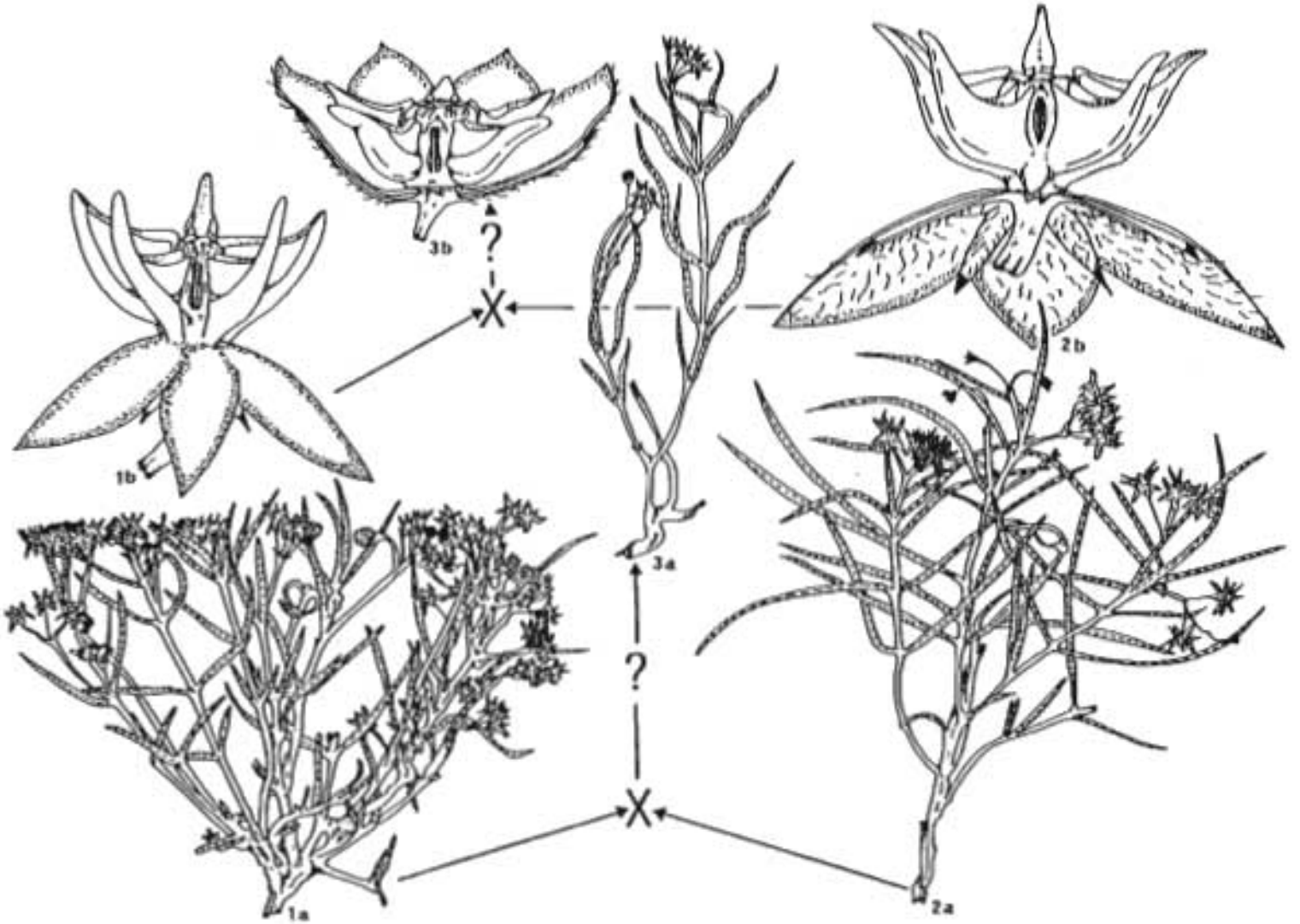


Figure 38. A comparison of the habit of: 1a. *Aidomene meyeriana* x0.9 (Hanekom 1624 PRE), 2a. *A. revoluta* x0.8 (Nicholas & Gibbs 1103 CPF), 3a. *A. brevipes* x0.8 (Young s.n. PRE 32446). And flower structure: 1b. *A. meyeriana* x11 (Hanekom 1624 PRE), 2b. *B. revoluta* x10 (Killick 960 PRE), 3b. *B. brevipes* x15 (Young s.n. PRE 32446). Drawings by A. Nicholas.

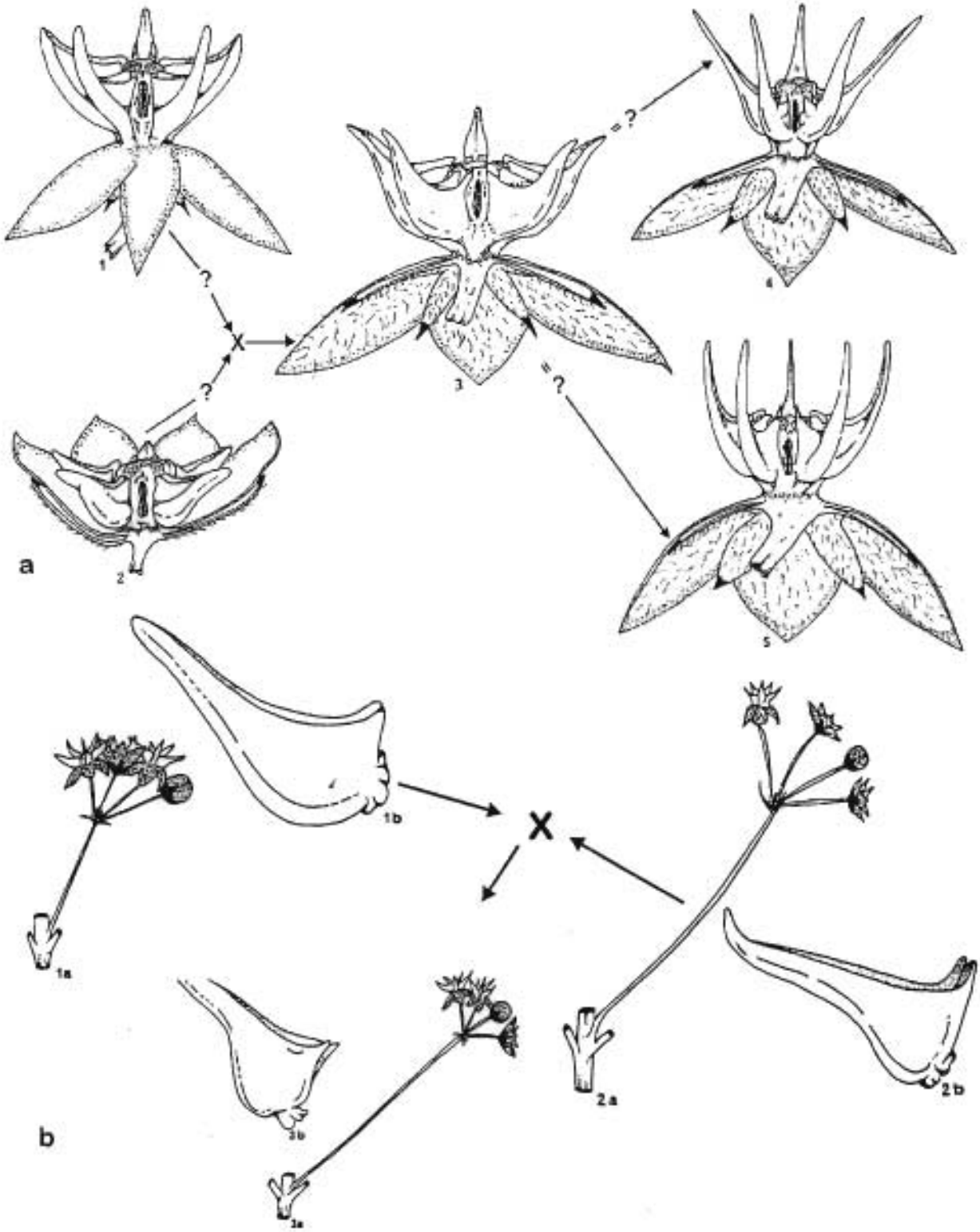


Figure 39. a. Comparison of the flower structure of: 1. *Aidomene meyeriana* x6 (Hanekom 16 PRE), 2. *A. brevipes* x8 (Young s.n. PRE 32446), 3. *A. revoluta* x5 (Killick 960 PRE) and two possible hybrid specimens 4. x5 (Steyn 991 NBG) & 5. x6 (Burtt Davy 1818 PRE). b. A comparison of peduncle length in: 1a. *A. revoluta* x0.5 (Killick 960 PRE), 2a. *A. aurea* x0.5 (Meeuse 9347 PRE), 3a. possible hybrid specimens x0.6 (Shirley s.n. NU 32473) and corona-lobe structure: 1b. *A. revoluta* x7 (Prosser 1295 J), 2b. *A. aurea* x12 (Meeuse 9347 PRE), 3b. possible hybrid specimen x8 (Dlamini *s.n.* NBG). Drawings by A. Nicholas.

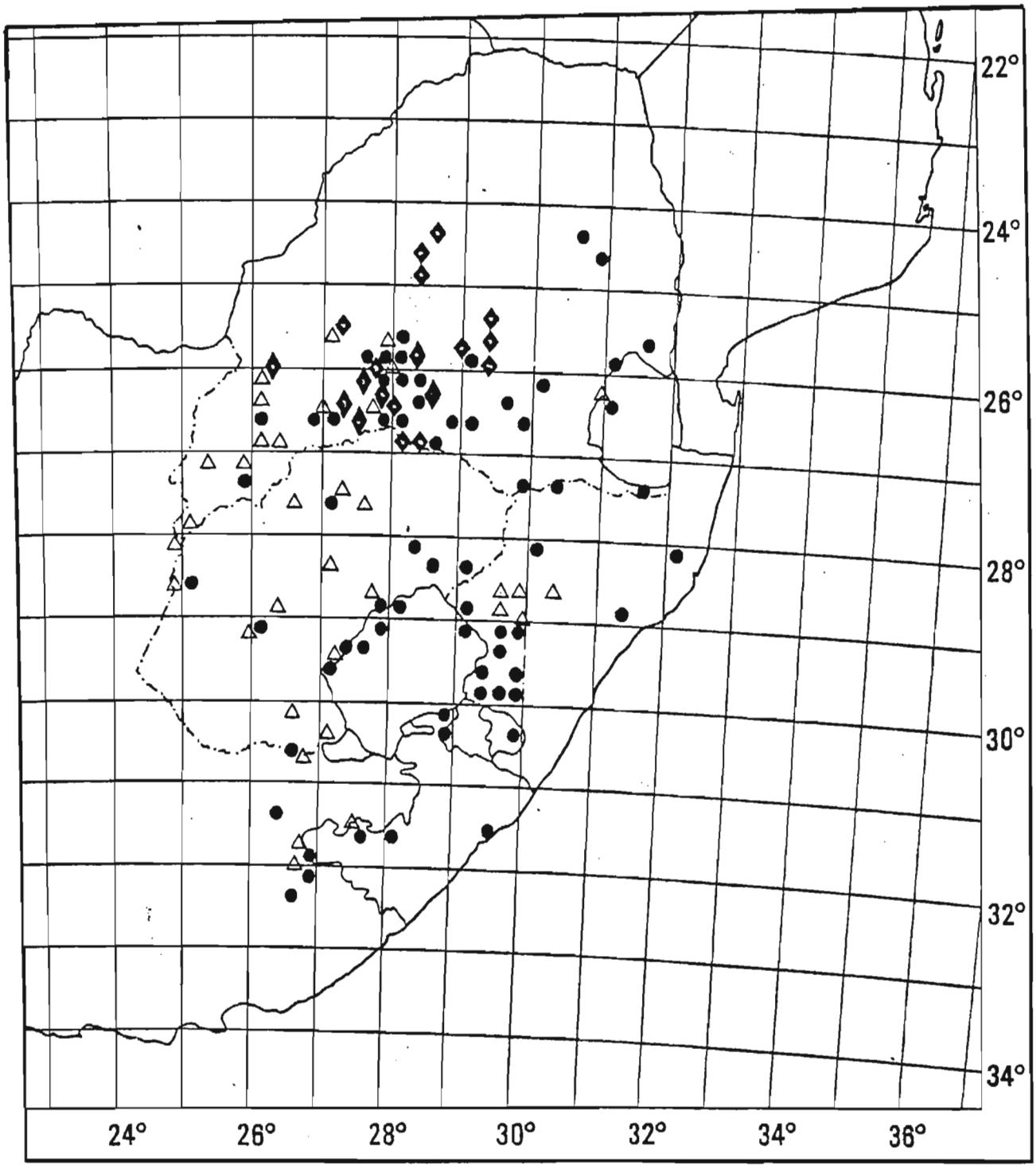


Figure 40. The comparative distribution of *Aidomene revoluta* (●), *A. meyeriana* (▲), and N.E. Browns [1908] suggested hybrid taxon *A. brevipes* (◆). This distribution and plus certain morphological characteristics suggest it is unlikely to be of hybrid origin between these two parent taxa.

Table 9: Comparison of *A. nana* and *A. hespera* (all measurements in mm)

Character	*A. nana*	*A. hespera*
Leaf length	55 to 58	16 to 68
Leaf width	±1	2 to 6
Petiole length	0 to 1	0
Pedicel length	6 to 7	7 to 9
Flower width	±11	±9
Flower height	±8	±5
Petal length	±5.8	±5.4
Petal width	±3.9	±3.5
Corona-lobe width	±2.2	±1
Corona-lobe height	±2.8	±2.3
Proximal corona-lobe appendages	Arm-like, flexed back towards the distal end of the corona	Dentate & erect
Corona-lobe distal end	Level with the proximal corona-lobe appendages	Lower than proximal corona-lobe appendages
Corona-lobe keel base	With a distinct notch where the triangular flap of tissue begins	With no distinct notch where the triangular flap of tissue begins
Anther-appendage length	±0.4	±1.2
Anther-appendage width	±1.1	±3.5
Pollinia length	±0.84	±0.92

PACHYACRIS Schltr. ex Nicholas & Goyder. *Gen. nov. Pachycarpi affinis.* ***Herba*** *perennis geophyticus.* ***Radi*** *tuber-caulus profunde infossus, angustus sed carnosus.* ***Caules*** *1—10 (-30) e terra prodiens, simplices vel parce-ramosi plerumque prostrati, interdum patentes vel erecti (50-) 100—600 (-750)mm longi.* ***Folia*** *ascendentia expansa, linearia, lanceolata, ovata vel elliptica, 10—110mm longa, (0.75-) 1.5—40 (-50)mm lata, margine plerumque laeve, aliquando revoluto, crispato et nervtura prominente, paginis ambobus hispidis; petiolo (0-) 1—16mm longo.* ***Inflorescentia*** *plerumque umbellifora, interdum corymbose vel subcorymbosa, plerumque hemispaerica vel globosa, plerumque solitaris et terminalis; pedunculo (6-) 30—100 (-150)mm longo.* ***Flores*** *(4-)6—40 (-50) in inflorescentia; pedicello (4.5) 6.5—25mm longo.* ***Corollae*** *plerumque reflexae aliquando erectae, lobi 3—8mm longae, 1.5—5mm latae.* ***Coronae lobi*** *cucullati, saccati vel*

unguiformis, solidi vel non-solidi cum sinu centrali, 1—7mm longi, 0.75—3.5mm lati, extremo superiori distali interdum acuto, plerumque obtuso vel erecto et rotundato, proximali superiori in dentes breves deltoideo-obtusos producto sed sine appendicis veris vel cum dentis acutis deltoideis, falcatis vel acutis, sinu saccato, centrali anguste canaliculato, vado vel nullo. ***Antherae appendices*** *ovatae, orbiculares, rhomboideae vel reniformes, apice integri, emarginato vel bifido.* ***Gynoecii*** *apex truncatus.* ***Folliculus*** *unicarpus, erectus, fusiformis vel lanciformis, 50—125mm longus, circa 12mm latus, laevis, echinatus vel longitudinaliter.* ***TYPUS****: Pachycaris tysoniana (Schltr.) Nicholas & Goyder, vide infra.*

Description: *Habit*: Perenial, geophytic herb with vegetative parts usually hispid occasionally pubescent; with milky latex. *Rootstock* a very deep-seated (over one meter long in mature plants), narrow cylindrical fleshy stem-tuber. *Stems* 1—10(-30), produced at ground level, simple or 2 to 3 branched near the base, rarely once or twice forked near the top, branches often dichotomous, usually procumbent or decumbent, occasionally spreading-erect to erect, (50-)100—600(750)mm long, laterally compressed or teretee. *Leaves* opposite, simple, entire, lying flat on the ground or ascending, spreading, or deflexed; blade linear, lanceolate, triangular, ovate, oblong, elliptic to almost round, 10—110mm long, (0.75-)1.5—40.0(-50.0)mm broad, base tapering, rounded, subtruncate, trullate, truncate, cordate to hastate, apex acute, acuminate to obtuse, sometimes with a small apiculus, margin usually smooth, sometimes crispate or undulate, occasionally revolute in narrow leaves, abaxial surface with midrib prominent, 2° and 3° veins also prominent in broader leaves, both surfaces hispid, scarbrous or pubescent; petiole 1—16mm long. *Inflorescences*: Umbel-like, often hemispherical or globose, usually solitary & terminal, occasionally 2 to 6 & then terminal & extra-axillary or subaxillary, (4-) 6—40(-50)-flowered, if peduncles of same length then inflorescences racemose on the same plant, if peduncles of different lengths then inflorescences subcorymbose to corymbose; peduncle (6-)30—175mm long. *Flowers* rotate, sometimes stelliferous, yellow, greenish yellow, brownish green, green & purple, greenish white & purple, dull purple, purple brown with yellow sides or yellowish white; pedicel (4.5-)6.5—25mm long. *Corolla* mostly reflexed (with lobe apicies flexed upwards), but sometimes suberect to erect (with or without lobe apicies inflexed); lobes oblong, ovate to narrow-elliptic, 3—8mm long,

1.5—5mm broad, sometimes apically twisted or notched, adaxial surface glabrous, abaxial surface usually pubescent to glabrous. *Staminal-corona* arising at the gynostegial column base or up to 2mm above it, either shorter, level with or occasionally exceeding the style-apex in height, usually with style-apex exposed, rarely incurved over and hidding it; lobes cucullate, saccate or claw-like, solid & fleshy or hollow with a central sinus, 1—7mm tall, 0.75—4.5mm wide, upper distal end usually blunt or erect & rounded, rarely pointed but without any true appendages, upper proximal ends blunt or with pointed deltoid, falcate to acute (usually short but sometimes long) teeth, rarely subulate, these may or may not rest on the style-apex or upper proximal ends absent, upper margin oblique or truncate (i.e. level), sometimes pinched inwards or with margins thickened, keel truncated or rounded & curved down towards the petal with or withour a thick ^-shaped ridge of tissue midway, sinus sac-like (sometimes narrow) to shallow & furrow-like or absent, orange, yellow, yellowish white, purple brown, or white. *Staminal-column*: anther-wings angular at the middle or in the lower half; anther-appendages broad-ovate to ovate, suborbicular to orbicular, subreniform to reniform, rhomboid, subquadrate, transversely oblong, apex obtuse, emarginate or rarely bilobed, usually decumbent or convivent on style-apex or rarely erect & rarely containing granules. *Style-apex* truncated, with a central depression surrounded by 5 swollen lobes corresponding with placement of the corpusculum, sometimes with five purple radiating lines from the middle. *Fruits*: Usually 1 by abortion, erect, fusiform to lanceolate, 50—125mm long, ±12mm wide, tappering to an obtuse or acute apical beak, smooth, puberulous, tuberculate, echinate or longitudinally echinate (with about 6 longitudinal series of small spines) with a mixture of stout and soft bristles; peduncle & pedicel usually recurved in fruit.

Discussion: Schlechter (1894) originally defined *Gomphocarpus* R. Br. section *Pachyacris* Schltr., as consisting of *Gomphocarpus tysonianum* (Schltr.) Schltr. [= *Xysmaloboium tysonianum* (Schltr.) N.E. Br.], *G. ochroleucus* Schltr. [= *X. gerrardii* Scott Elliot], and *G. acerateoides* Schltr. [= *X. acerateoides* (Schltr.) N.E. Br.]. He later (1894a) included *Gomphocarpus harveyanus* Schltr. [= *Xysmalobium prunelloides* Turcz.]. Schlechter (1894) originally described *X. tysonianum* as *Pachyacris capensis*, but without description. As a result, it is a *nomen nudum* and thus invalid under **ICBN** rules.

As *X. tysonianum* appears to be central to Schlechter's concept of *Pachyacris* it is chosen here as the type of the genus. In Willis (1985), the valid publication of *Pachyacris* is attributed to Bullock, but he never actually validated or effectively published the name. Langley and Stewart (1980) also intended to publish the name but some 19 years on this has not appared and is unlikely to do so. Although, nouns ending in the termination *–is* are usually male in gender, traditionally many genera ending as such are treated as female e.g.: *Calotropis*, *Oxytropis*, *Vitis* etc. We have continued with this tradition and treat *Pachyacris* a feminine. The genus, as defined here, contains species previously included in both *Asclepias* and *Xysmalobium sensu* N.E. Brown. These two genera were previously defined by the possession of a corona-lobe sinus (= *Asclepias*) or abscens of a corona-lobe sinus (= *Xysmalobium*). However, in the Asclepiadaceae corona-lobe evolution is determined by pollination forces which are limited in their diversity. As a result, unrelated species have evolved similar corona-lobes structure in response to similar pollinating forces, leading to the occurence of convergent evolution in this structure. Homoplasy is, as a result, common in this and other structures that particpate in pollination. Understandably, with the older and largely non-evolutionary paradigms that exsited at the turn of the century structures that looked similar were often lumped together thus placing a number of unrelated species together and creating paraphyletic genera such as *Xysmalobium*, *Asclepias* and *Schizoglossum*. Only recently has the appreciation of the malabitiy of the corona-lobe been understood and also the fact that this structure can in the same genus exhibit quite diferent shapes. In *Pachyacris* there has been an evolutionary trend from hollow corona-lobes to solid corona-lobes, a similar trend can be seen in the genus *Pachycarpus* (Nicholas & Goyder 1990) and *Pentarrhinum* (Liede & Nicholas 1992). In *Pachycaris* this trend can be traced from *P. albens*, with its deep sac-like sinus, to *P. monticola*, with its shallow sinus, to *P. xysmalobioides*, which is vertually without a sinus, to *P. tysoniana*, with its solid corona-lobes. Admittedly this trend could have proceeded in the other direction, or in both directions from an intermediate condition; the plesiomorphic condition still needs to be firmly established. However, as we believe it to be the most primitive of extant *Pachyacris*, we have placed *P. meliodora* first in our series. In *Pachycaris* hollow corona-lobes tend to be associated with reflexed corollas and solid corona-lobes with erect corollas. This probably has

something to do with the dynamics of pollinarium removal and insertion, and the way in which the insect's legs or proboscis is guided towards the base of the gynostegial-groove. The genus is readily recognized in the field by its habit: Plants usually have many stems produced at ground level from a very deep-seated fleshy cylindrical stem-tuber, these stems are in turn one to three branched (often dichotomously) near their origins, they are also usually procumbent or decumbent, even if this is only as they emerge from the stem-tuber, the leaves are usually broad with prominent veins beneath and rough to the touch, inflorescences are usually terminal and many flowered, the corona-lobes are generally the most prominent part of the flower. Some species may have one or two atypical characters but all, by and large, exhibit a majority of these correlated characters. Some exceptions include the narrow leaves of *P. flexuosa*, and the hidden corona-lobes of *P. parviflora* and allies. **Etymology**: *Pachy* (= thick) and *acros* (= at the tip, end or summit), this is probably in reference to the thick corona-lobes that mark the flower summit or tip.

Distribution: African endemic. Lesotho, South Africa [Northern, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape and Western Cape provinces] and Swaziland. Also in south central Africa.

Key to Species:

1a Corona-lobes solid, without a sinus 2

1b Corona-lobes not solid, with a sinus 15

2a Inflorescences terminal only 3

2b Inflorescences terminal & extra-axillary 7

3a Corona-lobes not exceeding the style-apex 4

3b Corona-lobes exceeding the style-apex 9

4a Petals 2—3mm long, white or greenish white ..... *P. baurii*

4b Petals 3—8mm long, brownish, with brown or pinkish red or yellow 5

5a Stems 1, erect, ±500mm long ..... *Pachyacris sp. nov. b*

5b Stems 3 or more, decumbent, 150—230mm long 6

6a Flowers yellow ..... *P. tysoniana*

6b Flowers pinkish red ..... *P. rhodantha*

7a Corolla reflexed ..... *P. xysmalobioides*

7b Corolla ascending-erect 8

8a Corona-lobes 1.5—2.5mm long, flexed slightly towards the flower center & hidden inside the corolla ..... *P. prunelloides*

8b Corona-lobes 2.5—5.5mm long, reflexed away from the flower center so that they protrude out from between the petals ..... *P. rhodantha*

9a Stems 50—125mm tall 10

9b Stems 126—250mm tall 12

10a Corolla 2—3mm long ..... *P. parviflora*

10b Corolla 4—6mm long 11

11a Leaves 12—34mm long. Corolla erect. Corona-lobe completely solid ..... *P. gerrardii*

11b Leaves 32—100mm long. Corolla reflexed. Corona-lobes almost solid with a small channel-like sinus ..... *P. monticola*

12a Petals with longitudinally divided gibbosity on the inner surface ..... *P. acerateoides*

12b Petals without a gibbosity on the inner surface 13

13a Corolla spreading to reflexed ..... *P. sulphrea*

13b Corolla erect to suberect 14

14a Flowers yellow or yellowish ..... *P. gerrardii*

14b Flowers pinkish red ..... *P. rhodantha*

15a Inflorescences terminal only 16

15b Inflorescences terminal & extra-axillary 43

16a Inflorescences with flowers 20 or more 17

16b Inflorescences with flowers less than 20 26

17a Peduncles 6—25mm long 18

17b Peduncles 26—150mm long 19

18a Corona-lobes 2mm long ..... *P. adscendens*

18b Corona-lobes 2.3—3.0mm long ..... *P. hastata*

19a Petals 4.0—5.5mm long 20

19b Petals 5.6—10.0mm long 22

20a Inflorescences 12—20-flowered ..... *P. adscendens*

20b Inflorescences 21—40-flowered 21

21a Corolla lobes 4.5—5.2mm long, 3.0—3.3mm wide ..... *P. vicaria*

21b Corolla lobes 4mm long, 2.5mm wide ..... *P. xysmalobioides*

22a Inflorescences 15—32mm wide 23

22b Inflorescences 35—67mm wide 24

23a Leaves 6—12mm wide. Petals 4.5—5.5mm long ..... *P. adscendens*

23b Leaves 20—35mm wide. Petals 7—8mm long ..... *P. macropus*

24a Leaves narrowly lanceolate, 6—12mm wide ..... *P. cooperi*

24b Leaves ovate, ovate-lanceolate to broad lanceolate, 13—38mm wide 25

25a Pedicels 25—36mm long. Petals erect, 9—10mm long ..... *Pachyacris sp. nov. a*

25b Pedicels 12—25 (-38)mm long. Petals reflexed, 6.5—8.0mm long ..... *P. albens*

26a Stems one, unbranched 27

26b Stems more than one & usually branched 35

27a Inflorescences 4—6-flowered ..... *P. crassinervis*

27b Inflorescences 7—15-flowered 28

28a Inflorescences pendulous ..... *P ulophylla*

28b Inflorescences erect 29

29a Plants with stems 150—300mm tall when in flower 30

29b Plants with stems 320—600mm tall when in flower 31

30a Peduncles 8—50mm long ..... *P. meliodora*

30b Peduncles 75—120mm long ..... *P. fallax*

31a Inflorescences 15—25-flowered 32

31b Inflorescences 4—12-flowered 33

32a Mature leaves ovate, ovate-oblong or linear-lanceolate,
4.5 to 22.5mm wide ..... *P. densiflora*

32b Mature leaves linear, 1.5 to 4mm wide ..... *Pachyacris sp. nov. c*

33a Stems with 3 to 6 but **usually 4** pairs of leaves. Inflorescences
in a terminal pair ..... *P. woodii*

33b Stems with more than 6 pairs of leaves. Inflorescences

solitary & terminal 34

34a Mature leaves lanceolate, 7 to 18.
Peduncles ±40mm long ..... *Pachyacris sp. nov. b*

34b Mature leaves linear, 1.5 to 4.0mm wide.
Peduncles 95 to 168mm long ..... *Pachyacris sp. nov. c*

35a Leaves 1.5 —4.5mm wide 36

35b Leave 5—25mm wide 37

36a Stems 100—145mm long. Leaves triangular, broader at the base then tapering to the pointed apex ..... *P. multicaulis*

36b Stems 150—600mm long. Leaves linear, same width throughout ..... *P. flexuosa*

37a Inflorescences 7—10-flowered 38

37b Inflorescences 11—30-flowered 39

38a Petals 4—5mm long ..... *P. multicaulis*

38b Petals 6—7mm long ..... *P. meliodora*

39a Petals 7—8mm long 40

39b Petals 4—6mm long 41

40a Petals 5.6—7.5mm long. Corona-lobes 0.5—1mm long ..... *P. albens*

40b Petals 7.8 —8mm long. Corona-lobes 1.1—2.2mm long ..... *P. macropus*

41a Inflorescences 38—50mm in diameter ..... *P. albens*

41b Inflorescences 18—37mm in diameter 42

42a Inflorescences 20—25-flowered. Petals 4mm long ..... *P. xysmalobioides*

42b Inflorescences 12—19-flowered. Petals 4.5—6.0mm long ..... *P. adscendens*

43a Stems 50—125mm long 44

43b Stems 150—600mm long 45

44a Petals 5.5mm long ..... *P. monticola*

44b Petals 6—7mm long ..... *P. meliodora*

45a Stems solitary 46

45b Stems more than one 47

46a Stems 150—150mm tall when in flower ..... *P. fallax*

46b Stems 300—600mm tall when in flower ..... *P. woodii*

47a Peduncles 75—120mm long, Gauteng & Northern provinces ..... *P. fallax*

47b Peduncles 12—75mm long, Western & Eastern Cape provinces & KwaZulu-Natal 48

48a Petals erect to suberect, corona-lobes claw-like, KwaZulu-Natal ..... *P. rhodantha*

48b Petals reflexed, corona-lobes slipper-shaped, Western & Eastern Cape provinces ..... *P. crispa*

1. *Pachyacris meliodora* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Schlechter 4373*, South Africa, Northern Province, near Sandloop, in sandy places, 03.02.1894, alt. 4600ft (= 1402m) [Holo. B† *n.v.*].

Gomphocarpus meliodorus Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 33 [1895]. **Type:** As above.

Asclepias meliodora (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As above.

Asclepias meliodora (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As above.

Asclepias meliodora (Schltr.) Schltr., var. *brevicoronata* N.E. Br., in Thisleton-Dyer Fl. Cap. 4(1): 700 [1908]. **Type:** *Pegler ex Bolus 10553*, South Africa, Noth West province, near Rustenberg [Holo. *n.v.* Isosyn. BOL].

Discussion: Although the corona-lobes of this species are somewhat like those of *P. hastata* (the distal upper end erect and overtopping the style-apex) it differs in its racemosely produced (rather than corymbosely produced) inflorescences, longer peduncles (60mm versus 30mm), lanceolate (rarely slightly hastate), velverty, dark green leaves (with generally only the midrib prominent) and with long petioles (fig. 40). *P. meliodora* is widely distributed but populations are few and widely separated; possibly indicating that this species was more common in prehistoric times (fig. 41)? Given this wide and fragmented distribution it is not surprising that this species is extremely variable, and has some of the largest (105mm long by 37mm wide) and smallest (10mm long by 1.5mm wide) leaves in the genus. Also, unlike any other asclepiad we have examined, the fruiting peduncle becomes very thick, thicker than the stems (5mm) and often longer than the entire plant (up to 100mm). Unfortunately, we have not seen the type of variety *brevicoronata* so have we been unable to reexamine the validity of this taxon. However, given the variability exhibited by this species, the shorter (apparently only just exceeding the style-apex) more pinched corona-lobes of var. *brevicoronata* is likely to be just part of the natural variation of this taxon. Another specimen (*Bell-John s.n.*) collected near the type locality of var. *brevicoronata* has slightly shorter corona-lobes but not short enough to warant varietal status. We have, as a result, decided to sink this variety rather than create a new combination that may prove superfluous. This species is found growing in open grasslands, often in bush veld, Acacia woodlands, Thornveld or in stony ground. It occurs at altitudes of between 150 and 2150 meters and flowers from October to May, peaking in December. The corolla varies from white to light green to yellow, while the corona is purple to dark purple to brownish, and the flowers give off a honey scent (hence the specific epithet *meliodora*). We have placed this species first in our series as its distribution, extremes in variation and fruit structure suggest that is the most plesiomorphic of the *Pachyacris* species.

Distribution: South African endemic [Northern, North West, Gauteng, Mpumalanga & KwaZulu-Natal provinces] (fig. 42).

Conservation Status: Low Risk (Least Concern). Although widely distributed this species is, now days, seldom collected and then generally only in fairly inexcessable areas. Said by collectors to be rare. It should be considered vulnerable.

Representative Specimens: Botswana: *Rogers 6244*, Lobatsi [BOL]. **South Africa:** Northern: *Park 32257*, Baiandbai, Zoutpansberg district [PRE with good rootstock]; *Leendertz 5592*, Warmbaths [PRE]; *Leach & Perry-Lancaster 16637*, Pietersburg [PRE]; *Hofmeyr 163*, Sunningdale Private Nature Reserve [PRE]; *Beyer 22259*, Griffen Mine [PRE]. North West: *Bell John s.n.*, Rustenburg district [J]; *Giffen 539A*, near Molopo river, Mafeking area [PRE]; *Barker 794*, Beesrekraal Game Reserve [PRE]. Gauteng: *Moss 14377*, Schoemansville [J]; *Smith 582*, Klapperkop, Pretoria [PRE]; *Repton 27*, Fountains Valley, Pretoria [PRE]. Mpumalanga: *Rudatis 9 & 10*, Buffelsvlei, Middleburg district [STE]; *Mogg 30693 & 31046*, Loskop Dam Nature Reserve [J]; *Barnard 285*, Sukakunie, Lydenberg district [PRE]; *Young A666*, Noitgedacht Mt. [PRE]; *Clark 1334*, Malelane Valley [PRE]; *Young A636*, Brandrai, Pilgrim's Rest district [PRE]; *Mogg s.n.*, Kaapmuiden, Barberton district [PRE 50200]; *Mogg s.n*, Kaapmuiden, Barberton district [PRE 50201 fruit only]; *Smuts & Gillett 2309*, Mauchaberg, Sabie [PRE]. KwaZulu-Natal: *Strey 5661*, Mkuzi [NH, PRE]; *Gibson s.n.*, Itala Nature Reserve [NU]; *Milton 160*, Misisamphi, Msinga [NBG]; *Plowes 6089*, near Estcourt [PRE]; *Gerstner 6890*, Makowe [PRE]; *Green 462*, Baavians Krantz, Weenen district [PRE]; *Tinley & Ward 50*, Mkuzi Game Reserve [PRE]. Swaziland: *Culverwell 1399*, Mbuluzi Nature Reserve [PRE]; *Karsten s.n.*, Big Bend, Hlatikulu district [PRE 31205].

2. *Pachyacris ulophylla* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Schlechter 11788*, South Africa, Mpumalanga province, near Komatipoort, Dec. 1897, 330 meters [Holo. B† *n.v.*]

Asclepias ulophylla Schltr., in Engl. Bot. Jahrb. 38(1). Beibl. 82: 32 [1905]. **Type:** As above.

Discussion: We have been unable to trace the type of this name. It has been suggested that it is related to *Aidomene humilis* (Schlechter 1905) or conspecific with it (Brown

1908). However, based on our knowledge of *A. humilis* and its distribution we feel that this is highly unlikely. Rather, the description of *P. ulophylla* suggests that it is allied to *P. meliodora*. Recently, a specimen has been collected (*Braun 880*) that not only fits the description of *P. ullophylla* but was also collected in the vacinity of the type; we believe it to be this species. In this specimen the plants are small, 820mm tall and stems are solitary. Leaves are petiolate, with blades narrow-ovate to ovate, 33—35mm long, 8—20mm wide, covered in white hairs and with only midrib prominent below. Peduncles are 44—50mm long, inflorescences pendulous and ±5-flowered, inflorescence bracts are persistent, filiform and 4.5—5.5mm long. Flowers are 8—9mm wide with pedicels 9—14mm long. Corona-lobes are subquadrate, 2.5—3mm tall, 1.5—1.8mm wide, with a distinct sinus. The translator-arms have large transparent wings. In this specimen the leaves resemble *Aidomene humilis*, and even *Schizoglossum elingue* and allies, rather than being typical of *Pachyacris*, however, they are also very closely approached by some specimens of *P. meliodora*. The corona-lobe is like like those of *P. albens* but much smaller.

Distribution: South African endemic [Mpumalanga province only] (fig.42).

Conservation Status: Data Defficent. Probably Critically Endangered.

Representative Specimens: South Africa: Mpumalanga: *Braun 880*, Malolotja Nature Reserve [PRE].

3. *Pachyacris crassinervis* (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Types:** *Burtt Davy 2988*, South Africa, Mapumalaga province, between Carolina and Oshoek. [Lecto. PRE]. Chosen here. *Burtt Davy 1692*, South Africa, Mpumalanga province, Rehbokdraai, near Nelspruit, 3600ft (= 1097m) [Isosyn. BOL] (fig. 40); *Burtt Davy 2775*, Swaziland, Mbabane, 4600ft (= 1402m) [Syn. *n.v.*]; *Burtt Davy 2830*, Swaziland, Mbabane, 4600ft (= 1402m) [Syn. *n.v.*]; *Bolus 12135*, Swaziland, between Bremersdorp & Mbabane, 2300—4000ft (= 701—1219m) [Isosyn. BOL] (fig. 41).

Asclepias crassinervis N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 671 [1908]. **Types:** As above.

Stathmostelma crassinerve (N.E. Br.) Bullock, in Kew Bull. 1953: 339 [1953].

Figure 41. *Pachyacris meliodora*: a. Whole plant showing habit (*circa* 200mm tall). *P. albens*: b. Whole plant showing decumbent habit, pendulous inflorescences (indicated with an arrow) & habitat; c. Inflorescences; d. Plant with fruit; e. Whole plant showing habit, note the stout cylindrical fleshy stem-tuber indicated with an arrow. *P. crassinervis*: f1. Isosyntype Burtt-Davy 1629; f2. Isosyntype Bolus 12135 and; f3 Rogers 11675 (BOL). Photographs: a by D. Plowes; b to e by A. Nicholas.

Discussion: *P. crassinervis* is immediately distinguished by its solitary decumbent (rarely procumbent) stem, linear to linear-lanceolate leaves with the thick midrib below taking up almost a third of the surface area (hence the specific epithet *crassinervis*), short peduncles (6 to 20mm) so that the inflorescences are not produced above the leaves, the corona-lobes are V-shaped with a thickened keel and ±1.5mm long upper proximal appendages (that project over the style-apex) and triangular pollinia. This species is related to *P. meliodora* and one specimen (*Rogers 11675* housed at GRA) has leaves that approach this species. On one specimen (*Throncroft 1171*) Schlechter has written *Asclepias thorncroftii* but this name was never published. Plants occur in grasslands and occur at altitudes of from 900 to 1400 meters. Flowering is from September to February, peaking December to January.

Distribution: Southern African endemic. South Africa [Mpumalanga province] and Swaziland (fig. 42)

Conservation Status: Low Risk (Near Threatened). This species is of restricted distribution centered in Swaziland and adjacent areas of Mpumalaga. Seldom collected.

Representative Specimens: Botswana: South Africa: Mpumalanga: *Thorncroft 19174*, Barberton [GRA, J]; *Rogers 23744*, Sabie [J]; *Rogers 27626*, Barberton [SAM]; *Deall 1351*, Sabie area [PRE]; *Venter 1489*, Saddleback Range, Barberton area [PRE]; *Walker 114*, The Gem, Ermelo district [PRE]; *Sidey 1594*, Iswepe, Piet Retief district [PRE]; *Thorncroft 1185*, Lomati Valley [PRE]; *Williamson 145*, Barberton district [PRE]; *Mogg 13684*, Rosehaugh, Pilgrims Rest district [PRE]; *Gunn s.n.*, Blairmore Ranch, Ermelo district [PRE]; *Acocks 12307*, near Ermelo [PRE]; *Thorncroft 1171*, Lomati Valley [GRA]; *Thorncroft 2846*, Barberton [GRA]. **Swaziland:** *Compton 29657*, Top of Komati Pass [NH]; *Rogers 11675*, Mbabane [GRA]; *Schlieben 9500*, Mbabane [PRE]; *Compton 27360*, Usutu forest [PRE]; *Compton 25355*, near Mbabane [PRE]; *Karsten s.n.*, Mpalaleni [PRE 31204].

4. *Pachyacris albens* (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Types:** *Drége (V,a) a,* South Africa, Eastern Cape province, near Geelhoutboom, alt. 800—1200ft (= 244—366m) [Holo. B† *n.v.*]. *Drége (V,b) b,* South Africa, Eastern Cape province, near

Omsamcaba, alt. 500—1000ft (= 152—305m) [Holo. B† *n.v.*]. *Drége (I, a) c*, South Africa, Eastern Cape province, Aliwal North, Witteberg, 5000—6000ft (= 1524—1829m) [Holo. B† *n.v.*].

Pachycarpus albens E. Mey., Comm. Pl. Afr. Austr.: 214 [1838]. **Types:** As above.

Xysmalobium albens (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As above.

Asclepias albens Schltr., in Engl. Bot. Jahrb. 21(5). Beibl. 54: 5 [1896]. **Type:** As above.

Gomphocarpus affinis Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 27 [1895]. **Type:** *Schlechter 3751*, South Africa, Gauteng province, near Wilge River [Holo. B† *n.v.* Iso. BOL, GRA, PRE]. Placed into synonomy here.

Asclepias affinis (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As for *Gomphocarpus affinis*.

Discussion: This is probably the most widespread species of *Pachyacris* (fig. 42), so it is not surprising that it is also quite varied over its range and a number of distinct ecotypes can be decerned but these do not deserve any nomenclatural recognition. One of the most common forms occurs along the Natal coast. In this form plants are smaller, and fewer stemmed, stems with fewer leaves, leaves broadly ovate and shorter, and longer peduncles (e.g. *Ward 6111* [NH], *Jacques 5419* [NBG], *Mogg s.n.* [PRE 50326]). In many ways this form appear similar to *P. vicaria*, although this may be through convergence rather than any distant hybridization event. The form found along the Zululand coast is also distinct: Having longer stems, narrow-lanceolate very hairy leaves and shorter peduncles (e.g. *MacDevette 119* [CPF]). Plants in the Natal Midlands, in the vicinity of Kunhardt's farm, are also distinct with lanceolate leaves that are darker green than usual (with venation less prominent), laxly flowered inflorescences and taller corona-lobes (e.g. *Kunhardt 47* [NH], *Schrire 708* [NH]). This latter specimen shows some affinity to *P. macropus* possibly indicating some degree of hybridization (both species are common in this area). In the Eastern Cape specimens, although quite distinct from *P. crispa*, seem to have taken on some of the characteristics of this species, however, we did not find any specimens that could be considered to be hybrids. The one possible expection being a specimen collected by Taylor (n° 4950 housed at NBG) at

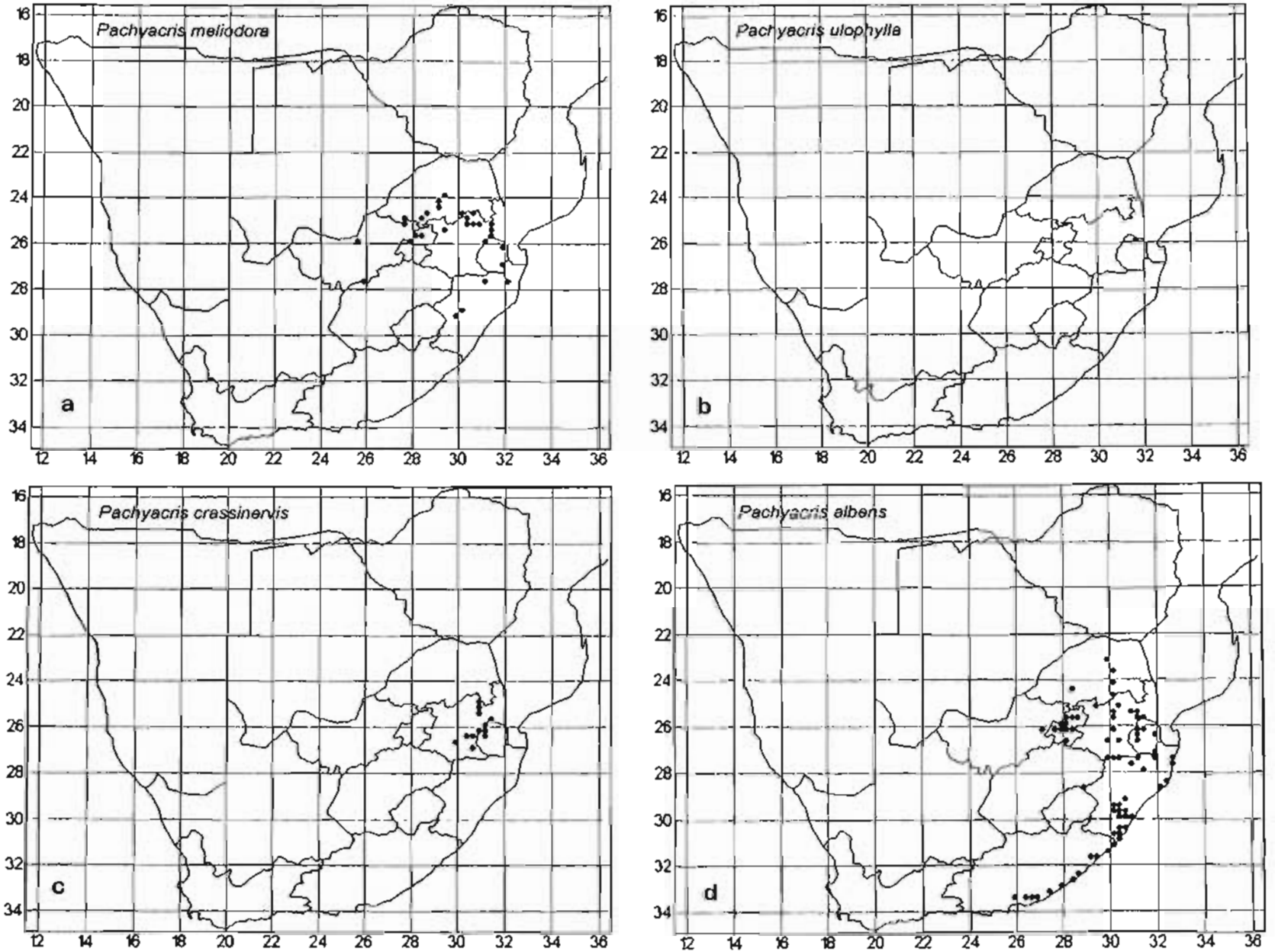


Figure 42. Distribution maps of: a. *Pachyacris meliodora*; b. *P. ulophylla*; c. *P. crassinervis* and; d. *P. albens*.

Shipton in the Martindale area. This specimen has corona-lobes typical of *P. albens*, but the leaves are very small (about 8mm long and 5mm wide) and crispate.

Brown (1908) distinguished *Asclepias affinis* from *Asclepias albens* by its more densely flowered inflorescences, oblong corona-lobes with its upper distal end protruding above the proximal end. *Asclpeias ablens* on the other had was defined by its fewer flowered inflorescences, more square corona-lobes with the upper margin truncate. However, the two forms intergrade with each other and, after examined a wide range of material, we could not find any difference of specific or intraspecific value between them. As a result, we have sunk *A. affinis* into *Pachycaris albens*. Although similar to *P. macropus*, *P. albens* can be distinguished from it by its hemispherical inflorescences, smaller and differently shaped corona-lobes, and corolla which is reflexed but not against the pedicel. According to Brown (1908), some of the collections in what was E. Meyer's herbarium are mixed collections with *Pachycarpus* and some other species. The type specimen from the Witteberg is said to have fusiform, beaked, echinate fruit which are found in this species. One specimen examined (*Codd 6665*) is unusual because it has erect rather than reflexed corolla, while another (*Mogg 6562*) which also exhibits an erect rather than reflexed corolla may either be a hybrid or something new; see *Pachyacris species nova A*.

This species (fig. 41) grows in open, annually burned, low to high altitude grasslands, usually appearing when the grass cover is still short and where it receives full sunlight. Often found in rocky areas, road reserves and firebreaks. Near the coast occuring in grass covered old dune systems. Plants flower from October to March, rarely as early as June, and are said to give off a pleasant scent. Altitude ranges from 10 to 1700 meters. The Zulu call this plant *Shongwa* and the Venda *Tshalale*, both apparently cook the young leaves as a type of spinach or *imifino* (Bryant 1966 and Fox & Norwood Young, 1982).

Distribution: Southern African endemic. South Africa [Northern, Gauteng, Mpumalanga, KwaZulu-Natal and Eastern Cape provinces] and Swaziland (fig. 42).

Conservation Status: This is a widespread and fairly common species in some areas. Although not yet threatened it grows in the grassland biome. This biome is, at present, the most heavily exploited in southern Africa with thousands of hectares every year

disappearing under agriculture and aforestation or being over taken by alien weed invasion. As a result, it is now become vunerable in some areas.

Representative Specimens: South Africa: Northern: *Scheepers 1068*, Piesang kop, near Duwelskloof [PRE]; *Rogers 18036*, Bodjadjes, Pietersburg [BOL, J, NH]; *Gerstner 6944*, Henob's River [PRE]; *Breyer 19584*, Louis Trichardt [PRE]. North West: *Sutton 512*, Goedgedacht [PRE] Gauteng: *Burke s.n.*, Magaliesberg [TCD]; *Eshuis s.n.*, Pretoria [PRE 51762]; *Liebenberg 8515*, Kelland, Johannesburg [PRE]; *Mogg 36039*, Isaac Stegmann Nature Reserve [J]; *Burtt Davy 15011*, Vereeniging [J]; *Werdermann & Oberdieck 1245*, Koedoesport [PRE]; *Gilfillan s.n.*, Johannesburg [GRA]; *Moss 22358*, Morningside [J]; *Thode A1735*, Pretoria [NH]; *Smith 1121*, between Lyttelton & Irene [PRE]; *Macnae 1395*, Melville Koppies [J]; *Hutchinson 2611*, between Irene & Johannesburg [BOL, PRE]; *Pole Evans s.n.*, between Irene & Lyttelton [PRE with flowers & fruit]. Free State: *Roux 872*, Sterkfontein Dam [NBG]; *Thode 8449*, Fasihoek [STE]. Mpumalanga: *Liebenberg 37*, Taflekop, Ermelo District [BLFU]; *Wyate 29*, Nigel [NU]; *Burtt Davy 1499*, White River [PRE]; *Acocks 16608*, near Middleburg [PRE]; *Thorncroft 3*, Barberton [NH]; *Devenish 307*, Mooihoek [PRE]; *Gilfillan 7213*, near Witbank [GRA]; *Moss & Party 21393*, Tweefontein, Balfour [J]; *Acocks 20893*, near Groblersdal [PRE]; *Codd 3249*, near Lydenburg [PRE]; *Collins 13926*, Ermelo [PRE]; *Burtt Davy 5452*, Ermelo [PRE]; *Galpin 13759*, Dullstroom [PRE]; *Mogg s.n.*, Barberton area [PRE 50294]; *Buitendag 1023*, Eerstegeluk, Uitkyk [PRE]; *Kluge 363*, Witklip [PRE]; *Codd 6665*, near Lydenburg [PRE - but corolla erect & not reflexed!]. KwaZulu-Natal: *Nicholas 988*, Neethling's farm, Oribi Gorge [CPF, NH, PRE]; *Nicholas 1006*, Richmond district [NH]; *Nicholas 1033*, Dargle area [NH, NU]; *Nicholas 1044*, Durban [NH, NU]; *Nicholas 1763 with van den Berg*, near Bloedriver [CPF, NH]; *Nicholas 2032 with King*, World's View, Pietermaritzburg [NH]; *Nicholas 2791*, Vernon Crooks Nature Reserve [UDW]; *Nicholas 2723 with Poorun*, near Byrne [UDW]; *Venter 1055*, Umhlatlizi flats [BLFU]; *Abbott 437*, Umtamvuna, Goyosa [NH]; *Strey 5067*, Mpangazi-Bazwana sandflats [NH & PRE both with flowers & fruit]; *Schlechter 6682*, near Umkomanzi river [BOL, JF, SAM, STE]; *Thode 2578*, Kenterton [JF, STE]; *Melain s.n.*, Uvongo [NH 47273]; *Johnstone 586*, Hlobane [NH]; *MacDevette 1440*, Cedara State Forest [NH, PRE]; *Wood 11076*, Field's Hill [NH, PRE]; *Retief 858*, Manzengwenya [PRE];

Germishuizen 1767, near Margate [PRE]; *Pooley 235*, Lake Sibayi [NU]; *Krauss 84*, Port Natal (= Durban) [TCD]; *Thode 2775*, Krantzkop [JF, STE]; *MacOwan 227*, Botha's Hill [GRA, TCD]; *Schrire 1578*, Greytown [NH]; *Green 371*, Middlerest/Joubert Vlei Road [NH]; *Jacques 5419*, Port Edward [NBG]; *Gerrard & McKen 826*, near Durban [TCD]; *Wood 1029*, near Durban [SAM]; *Trauseld 118*, Royal Natal National Park [PRE]; *Kok & Pienaar 1219*, near Greytown [PRE]; *Williams 855*, KwaMbanambi, Longepan [PRE]; *Pienaar 768*, near Umtamvuna River bridge [PRE]; *Brown & Shapiro 512*, Itala Nature Reserve [PRE]. Eastern Cape: *Nicholas 2320 with Smook & Hutchings*, Mkambati Nature Reserve [NH]; *Nicholas 2708*, Suurberg National Park [PRE with flowers & fruits]; *Barker 1422*, East London [NBG]; *Nicholas 2813 with DC. Nicholas*, between Coombs & Trappes [UDW]; *Potts 1792*, East London [BLFU]; *Dold 913*, Grey Reservoir [GRA]; *Smith 3832*, East London [PRE flowers & fruit]; *Galpin 246*, near Grahamstown [PRE]; *Flanagan 392*, near Kei Mouth [GRA, PRE, SAM]; *D'Urban 67*, Grahamstown [TCD]; *Moss 16153*, between Umtata & St. Johns [J]; *Dold 605*, Buchamwoods Reserve [GRA]; *Daly 10639*, Coldspring [PRE]; *Bolus 6697*, Round Hill, lower Albany [BOL, PRE]; *Compton 17814*, near Kidd's Beach [NBG]; *Thode 6471*, East London [STE]; *East London Museum s.n.*, Bonza Bay [NBG 43954]; *Dyer 4537*, between East London & Peddie [GRA]; *Tyson 3118*, Malowe [SAM]; *Hilner 265*, Overton [GRA]; *Strey 4494*, Mzamba [NH]; *Pegler 652*, 13th Moch Cove [BOL, PRE]; *Giffen s.n.*, Kidds Beach [UHF]; *Jordaan 979*, Mkambati Nature Reserve [PRE]; *Mogg 13544*, Umyamba hills [PRE]. **Swaziland:** *Rogers 11674*, Mbabane [with flower & fruit PRE]; *Compton 27361*, Usutu forest [PRE]; *Bayliss 2072*, Forbes Reef [NBG]; *Compton 25627*, Malkerns [NH]; *Hobson 2149*, Nyokane, below Enkaba Trig Beacon [PRE]; *Germishuizen 6093A*, Nkomati River, by New Bridge [PRE]; *Compton 30375*, Evelyn Baring bridge [PRE]. **Without Precise Locality:** *Drége s.n.* [TCD probably type].

5. *Pachyacris sp. nov. a*

Discussion: Vegetatively and florally this species is similar to *P. albens*. However, it differs from this species as follows: The leaves are broadly lanceolate (61—70mm long, 30—35mm wide), with a shallowly concave base and petioles 5.6—11mm long. The

inflorescences are terminal on a peduncle 98mm long and 20-flowered. Pedicels are 25—36mm long and flowers slightly larger than those of *P. albens*. Calyx and corolla are erect, with sepals and petals 9—10mm long (petals in *P. albens* are 6.5—8mm long). The corona-lobes are similar to those of *P. albens* (subquadrate in side view) but unlike this species there is a small vertically placed tongue in the sinus.

Distribution: South African endemic (KwaZulu-Natal province only) (fig.43).

Conservation Status: Data Deficient, Known from only one specimen.

Representative Specimens: KwaZulu-Natal: *Mogg 6562*, Allerton [PRE].

6. *Pachyacris macropus* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Types:** *Wood 4544*, South Africa, KwaZulu-Natal province, near Lynedock, in grassland, 24.02.1892, alt. 4000—5000ft (1219—1524m) [Holo. B† *n.v.*]; *Wood 5374,* South Africa., KwaZulu-Natal province, near Mooi River, 31.01.1894, alt. 4000—5000ft. (1219—1524m) [Holo. B† *n.v.*].

Gomphocarpus macropus Schltr., in Journ. Bot.: 353 [1894]. **Types:** As above.

Asclepias macropus (Schltr.) Schltr., in Journ. Bot.: 456 [1896]. **Types:** As above.

Discussion: *P. macropus* can immediately be distinguished by its very large corona-lobes with their distal end extended into a long erect tail-like appendage that greatly overtop the style-apex. This species is similar to *P. albens* but differs in its remarkable corona-lobe, globose rather than hemispherical inflorescences and corolla completely reflexed so that it hugs the pedicel (fig. 44). Two specimens collected on Mount Engcoba in the Eastern Cape province (*Flanagan 2773 & 2662* housed in PRE) have some *P. albens* features and may represent hybrids with this species. Plants are found growing in midland and upland grassveld (often in sourveld) which is usually but not always annually burned. *P. macropus* flowers between December and March and occurs at altitudes of between 900 and 2000 meters. Plants are occasional.

Distribution: South African endemic [Mpumalanga, Free State, KwaZulu-Natal & Eastern Cape provinces] (fig. 43).

Conservation Status: Vulnerable in many areas, and threatened in Mpumalanga and Eastern Cape provinces.

Representative Specimens: South Africa: Mpumalanga: *Hamilton 1174*, Lake Chrisse, Carolina District [PRE]; *Burtt Davy 984*, Experiment Farm, Ermelo District [PRE]; *Burtt Davy 1315*, Belfast [PRE]; *Collins 6342*, Ermelo [PRE]; *Balsinhas 2912*, Nooitgedacht Research Station [PRE]. Free State: *Venter 1533*, near Maraiskop [PRE]; *Müller & Viljoen 12*, Farm Groenkloof near Harrismith [PRE]; *van der Zeyde s.n.*, Botanic Garden (growing wild), Harrismith [NBG 89879]; *Thode 8394*, Fasihoek [JF, STE]; *Junod 17534*, Witzieshoek [PRE]; *Bamps 7177*, Drakensberg Gardens [PRE]; *Blom 234*, Beaucheff Abby, Harrismith [PRE]; *Jacobsz 611*, Rensburgskop, Swinburne [PRE]. KwaZulu-Natal: *Nicholas 1798 with Fokkens & McLoughlin*, Dargle State Forest [CPF, NH]; *Nicholas 2717 with Poorun*, near Nottingham [UDW]; *Balkwill 1304 with Manning & Cadman*, Dargle area, near Kilgobbin cottage [NU]; *Schrire 1649*, Cathedral Peak [NH]; *Lavranos 15222*, near Karkloof [PRE]; *Killick 3690 with Vahrmeÿer*, Impendhle district, upper Umkomaas [NH]; *Acocks 13996*, Tabamhlope Research Station [PRE]; *Harriss 164*, Fort Nottingham commonage [NU]; *Maurice & Evans 720*, Costmore [NH]; *Huntley 141*, Tillietudlem, Impendhle [NU]; *Wood 9764*, Drakensberg [PRE]; *Rennie 896*, Waterford airstrip [NU]; *Thode 2576*, Olivier's Hoek Pass [JF, STE]; *Wood 8209*, van Reenens [NH]; *Stewart 1945*, van Reenen's pass [NU]; *Graham 59*, van Reenen [NU]; *Wood 7737*, Lidgetton [SAM]; *Wood 3562*, Tugela Falls [NH]; *Trauseld 568*, Giant's Castle Game Reserve [NU]; *Moll 3455*, Farm Ehlatini, Karkloof [NH]; *Green 404*, Hidcote [NH]; *Pienaar 479*, near Cedara [PRE]; *Galpin 14722*, Greytown [PRE]; *Killick 3758 with Vahrmeÿer*, Mkomanzana valley [PRE]; *Smuts 1563*, Dargavel farm, near Nottingham Road [PRE]; *Arnold 1281*, between Estcourt & Thabamhlope [PRE]. Eastern Cape: *Bolus 10209*, between Elliot & Ugie [BOL, PRE]; *Sole 1*, near Umtata [NBG]; *Flanagan 2662*, Engcoba [SAM].

7. *Pachyacris adscendens* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 596,* South Africa, Mpumalanga province, near Barberton, Oct. 1889, alt. 800m. [Holo. B†. Iso. PRE].

Gomphocarpus adscendens Schltr., in Engl. Jahrb. 18(5). Beibl. 45: 16 [1894]. **Type:** As above.

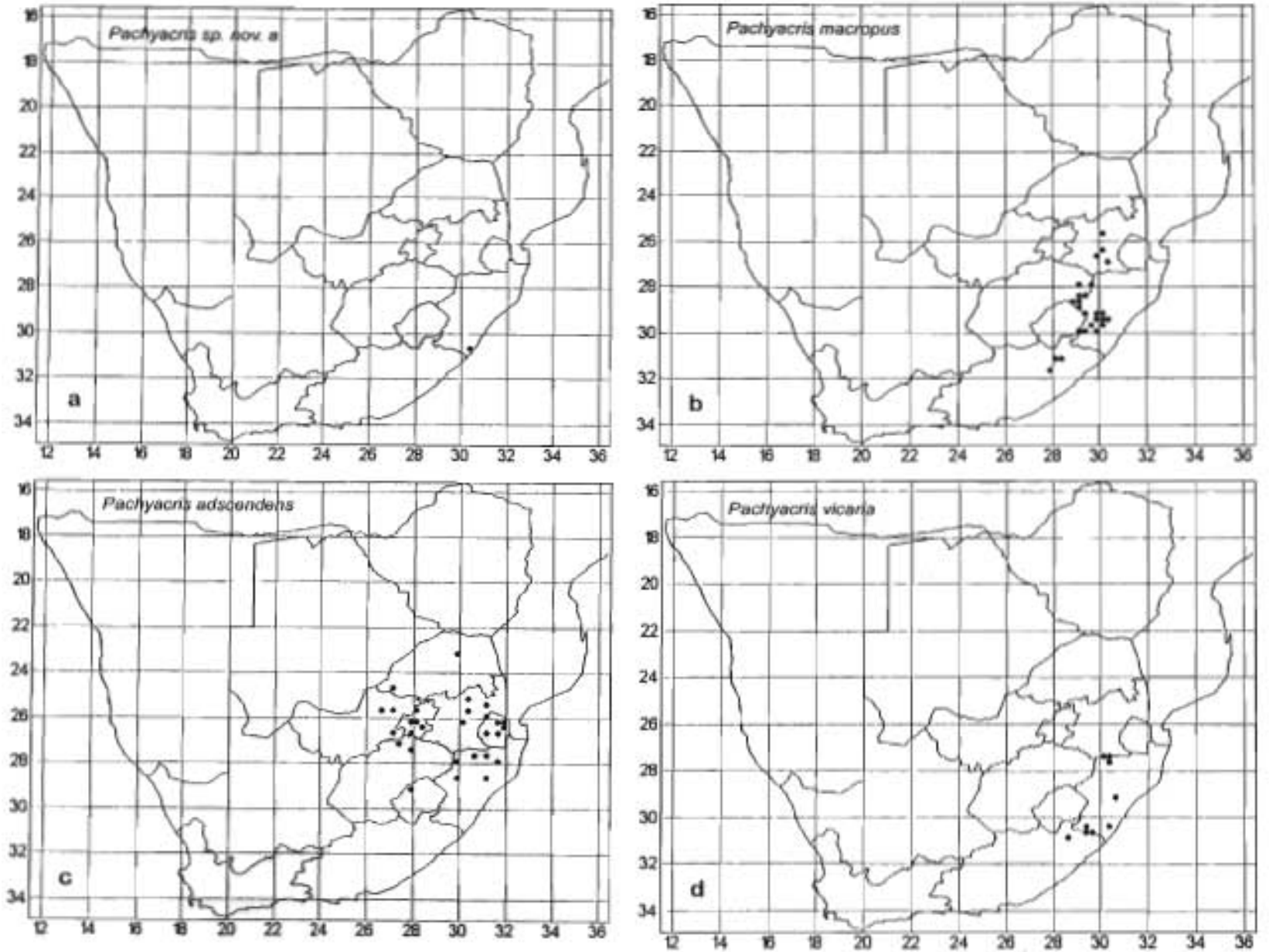


Figure 43. Distribution maps of: a. *Pachyacris sp. nov. a*; b. *P. macropus*; c. *P. adscendens* and; d. *P. vicaria*.

Asclepias adscendens (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As above.

Discussion: This species (fig. 44) differs from *P. albens* and *P. macropus* in its smaller stature, inflorescences and flowers. In this it is similar to *P. crispa* and *P. vicaria*, however, it differs from these species in its more northerly distribution, more dichotomously branched stems (this branching occuring throughout rather than being restricted to the stem base), differently shaped and harshly haired leaves (which are ascending-erect rather than spreading) and differently shaped corona-lobe. *P. adscendens* also differs in its densely bristle covered follicles (fig. 44). Plants are found growing in open, often but not always unburned, highland grasslands. Often found in stony situations and said, in Mpumalanga, to occur in sourveld on rocky hillsides or bankenveld. The plants found in Swaziland form a distinct ecotype with leaves narrower and longer than elsewhere, and plants more lax in appearance. In this they begin to resemble *P. densiflora* which is also common in this African Kingdom and may indicate some hybridization event; *Compton 24650* collected at Balegane Road and housed at NBG is a good example of such a possible hybrid specimen. *P. adscendens* flowers between September and January, peaking in October and being more or less finished by the end of December; although their is one record as late as March. This early flowering time sets it apart in the genus. Flowers are also said to be sweetly scented, especially towards evening (Anonymous 1926). Plants occur at altitudes of between 450 and 1750 meters. The name *Ntsime* appears on a *Dieterlen 1209* [housed in PRE] and may refer to the Sotho name for this plant. While *Gerstner 4432* [housed at NH] mentions that the Zulu eat this species raw as a vegetable; the name *eHoloba* occurs on his label. Illustrated in Flowering Plants of Southern Africa (Anonymous 1926), although the corona-lobes are inaccurately figured.

Distribution: Southern African endemic. Lesotho, South Africa [Northern, Gauteng, KwaZulu-Natal & Mpumalanga provinces] and Swaziland (fig. 43). A collection apparently made by *Tyson* at Mount Currie (n° *3117* housed at SAM) may have the wrong label information as this species is unlikely to occur in the Eastern Cape Province especially in what was the old Transkei.

Conservation Status: At risk in many areas, especially in the Gauteng province.

Figure 44. *Pachyacris macropus*: a. Whole plant showing habit & habitat (400mm tall); b. & c. Close up of flowers showing color variation. *P. adscendens*: d. Whole plant with flowers & fruit showing habit & habitat (250mm tall); e. Close up of the heavily echinate fruit; f. Close up of

Representative Specimens: Lesotho: *Dieterlen 1209*, Mission Station, Maphulteng [PRE, SAM]. **South Africa:** Northern: *Rogers 21691*, Louis Trichardt [J, NH]. North West: *Westhuizen 915*, Dassiesrand [PRE]; *Pegler 978*, Rustenburg [BOL, GRA, PRE]; *Sutton 811*, Swartuggens [PRE]; *Louw 1029*, Potchefstroom [PRE]; *Goosen 1682*, Potchefstroom area [PRE]. Gauteng: *Nicholas 2704*, growing wild in the Botanic Gardens Pretoria [PRE]; *Schlechter 1262*, Heidelberg [PRE]; *Schlechter 3525*, Heidelberg [BOL, GRA, J, NH, PRE], *Forbes 816*, Tussenkoppies near Kiblei Park [J]; *Leendertz 3495*, Pretoria [GRA, PRE]; *Prosser s.n.*, Kempton Park [J A40] *Pott 3873*, Vereeniging [GRA]; *Moss 13579*, Witpoortjie Kloof [J]; *Liebenberg 3163*, Brooklyn [PRE]; *Smith 749*, Meinitjies Kop, Pretoria [PRE]; *Phillips 3140*, Groenkloof [PRE]; *Moss 5582*, Thorntree Kloof [J]; *Repton 25*, Fountains Valley [PRE]; *Behr 621*, Transvaal Botanic Garden (growing wild), Roodepport [PRE]; *Bruce 20*, near Krugersdorp [PRE flowers & fruit]; *Phillips 3140*, Pretoria [PRE]. Mpumalanga: *Roberts 15864*, Arnhemburg [PRE]; *Holt 28436*, Plaston [NH]; *Codd & de Winter 3279*, near Lydenburg [PRE]; *Young A382*, Boschhoek [PRE]; *Onderstall 875*, between Nelspruit & Barberton [PRE specimen atypical]; *Leipoldt 18628*, Carolina [PRE]; *Galpin 13088*, Machadodorp [PRE]; *Holt 33*, Plaston [PRE]. Free State: *Goosen 553*, Heibron [BLFU, PRE]; *du Preez 333*, Vredefort, Gatoma [BLFU fruit only]. KwaZulu-Natal: *Strey 9950*, Harts hill near Colenso [NH]; *Buthelezi 257*, near Newcastle [NH]; *Gerstner 4432*, Nongoma district [NH]; *Hilliard & Burtt 8567*, Itala Nature Reserve [NU, duplicate at E not seen]; *Thode 2776*, Warrock [STE]; *Germishuizen 2413*, near Newcastle [PRE]; *Germishuizen 2363*, Paulpietersburg [PRE]. **Swaziland:** *Dlamini s.n.*, Bulunga Poort [NBG 71709]; *Dlamini s.n.*, Bulunga [NH 111130 flowers & fruit]; *Karsten s.n.*, White Mbuluzi river [NBG 84521]; *Dlamini s.n.*, New Mankaiana [NBG]; *Stewart 8901*, without precise locality [GRA]; *Compton 29305*, near Stegi [NH]; *Culverwell 1186*, Ndzindza Nature Reserve [PRE]; *Compton 29200*, Mankaiana [PRE]; *Karsten s.n.*, Bulunga Poort [PRE leaves large].

8. *Pachyacris vicaria* (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Type:** *Tyson 1749*, South Africa, Eastern Cape province, Ford Donald [Holo. *n.v.* Iso. BOL, SAM].

Asclepias vicaria N.E. Br., in Thisleton-Dyer Fl. Cap. 4(1): 709 [1908]. **Type:** As above.

Discussion: Although similar to *P. albens* in leaf shape it differs in that these are smaller and thinner textured, inflorescences are smaller, and the corona-lobes are smaller and quite differently shaped (fig. 45). The leaves in their thinner texture approach *P. crispa* var. *plana* but differs from this taxon in that the leaves are ovate rather than oblong, the corona-lobes are also smaller and differently shaped. *P. vicaria* has an unusual distribution, the bulk of populations are found in southern Natal (from Weza to Greytown) and Eastern Cape where it borders southern Natal, there is then a gap of hundreds of kilometers before it is once again found on the mountanous escaparment of northern Natal and boardering areas of Mpumalanga. Possibly this disjunct distribution could indicate that *P. vicaria* was at some stage more widely distributed than now? Interestingly there is a difference in flower color between the southern and northern populations. The southern plants have corolla and corona creamy green and often tinted with purple, the northern plants have corolla and corona dark yellow, buff yellow or yellowy green, or corolla reddy mauve and corona green. These northern populations may have also, to a degree, hybridized with *P. adscendens* as a few specimens, such as *Harriss 145*, seem to have some characteristics of this species. Plants are found growing in open grassland, usually amongst rocks, and occur at altitudes of between 1300 and 2000 meters. *P. vicaria* flowers from December to Febraury; peaking in January. Plants are said by collectors to be rare.

Distribution: South African endemic [Eastern Cape, KwaZulu-Natal & Mpumalanga provinces] (fig. 43).

Conservation Status: Low Risk (Least Concern).

Representative Specimens: South Africa: Mpumalanga: *Devenish 1227*, Wakkerstroom [PRE]; *Mauve 5251*, Wakkerstroom border with Natal [PRE]. KwaZulu-Natal: *Harriss 144 & 145*, Nauwhoek farm, Utrecht district [NU]; *Germishuizen 1818*, between Highflats & Umzinto [PRE]; *Wylie s.n.*, Greytown district [NH 22469]. Eastern Cape: *Schrire 783*, Weza Forestry Reserve [NH], *Coleman 833*, near Kokstad [NH]; *Hutchings 976*, Lahlangubo [NH]; *Wood 143*, Mondwana [NU]; *Strauss 83*, Ingeli Mountain [NBG]; *Sister Stephany 607*, Mount Currie [PRE]; *Coleman s.n.*, Weza [NH 64900].

9. *Pachyacris crispa* (Berg.) Nicholas & Goyder. *Comb. nov.* **Type:** *Grubb s.n.*, South Africa, Western Cape Province, *e Cap. b sp* (= Cape of Good Hope) [Holo. S. *n.v. fide* Wijnands (1983)].

Asclepias crispa Berg., Descr. Pl. Cap.: 75 [1767]. **Type:** As above.

Gomphocarpus crispus (Berg.) R. Br., preprint of Mem. Wern. Soc. 1: 38 [1810]. **Type:** As above.

Pachycarpus crispus (Berg.) E. Mey., Comm. Pl. Afr. Austr.: 214 [1838]. **Type:** As above.

Xysmalobium crispum (Berg.) Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above.

Asclepias sinuosa Burm. *f.*, Prodr. Cap. 7 [1768]. **Type:** *Burman s.n.*, Without precise locality [Lecto. G *n.v.*] *Fide* Wijnands 1983.

Asclepias undulata L., Mant. 2: 215 [1769] non L., Sp. Pl. edn. 1(1): 214 [1753]. **Type:** *Without collector, collector's number or locality* [Lecto. LINN 310.3]

Asclepias repanda Steud., Nom. Bot. ed. 1: 77 [1821]. **Type:**

Gomphocarpus hastatus E. Mey. var. *angustifolius* Meisn., in Hook. Lond. Journ. Bot. 2: 545 [1843]. **Types:** *Krauss s.n. (IV.C.b)*, South Africa, Eastern Cape province, George district, Knysna, river near Melkhout Kraal, on grassy hills, Feb. 1839 [Holo. *n.v.*]; *Krauss s.n. (IV.C.a)*, South Africa, Eastern Cape province, Zwellendam district. Dec. 1838 [Holo. *n.v.*].

Gomphocarpus arenarius Schltr., Abhandl. Bot. Ver. Brandenb. 35: 52 [1893]. **Type:** *Schlechter 533,* South Africa, Western Cape province, foot of Mostertsberg near Ceres Road, Jan. 1892, alt. 260m. [Holo. B† *n.v.*]

Asclepias sabulosa Schltr., Journ. Bot. 4: 454 [1896]. **Type:** As for *Gomphocarpus arenarius.*

Discussion: Wijnands (1983) deals in detail with the synonomy and typification of *P. crispa*. There are three specimens in the Linnean herbarium and Wijnands seems to have choosen LINN 310.3 as the type of *Asclepias undulatum* L *sensu* 1769. This specimen has *undulatum* written on it and subsequently crossed out with the name *crispa* then written next to it. LINN 310.2. is also this species and although not as generous as LINN 310.3 it does have better flowers. LINN 310.4 also has *crispa* and *undulatum* written on it but is actually *Pachyacris albens*. Strangely, Linnaeus (1753) also used *Asclepias*

undulatum for what is now *Xysmalobium undulatum* based on another specimen LINN 310.1. Wijnands (1983) says that he knows no other example where Linnaeus used the same epithet for different species of the same genus in one publication. Until one of the types of *Gomphocarpus arenarius* can be traced and examined we are treating it as conspecific with *Asclepias crispa* var. *crispa;* whose description it matches.

This widely distributed species varies quite considerably and Brown (1908) divided it into three varietal types. These three taxa are easily discerned but they are not of equal status. Variety *plana* only occurs in the very east of the distribution range and is morphologically distinct with vertually no intermediates between it and the other two varieties known. A case could be made to elevate *plana* to subspecific status, however, we have decided to maintain it at varietal level to make (the routine) identification of these entities easier Variety *crispa* has more crispate leaves (which are linear-triangular) and a more westerly distribution, while variety *pseudocrispa* has smooth leaves (which are linear) and a more easterly distribution. However, these two varieties intergrade and numerous intermediates can be found. Also, our definition of varieties *crispa* and *pseudocrispa* are a bit different from that of Brown's (1908). For instance, *Daly 584* (housed at GRA) which Brown cites as variety *pseudocrispa* has linear-triangular leaves with trullate to truncated bases and crispate margins and, despite its easterly distribution, this speciemen is typrical of variety *crispa*. Despite the gross morphological differences between these infraspecific taxa, the floral structure, in particular the corona-lobes, are quite constant throught out this species wide distribution range. The flowers of these plants give of a pleasant but mild sweetish scent. According to Watt & Breyer-Brandwijk (1962) this taxon is diuretic. A decoction or infusion, presumably of the swollen cylindrical root, has been used to treat dropsy. It has also been used as a tincture for colic. The root can, apparently, also be used as an emetic and purgative, and has caused poisoning in animals. Symptoms of poisoning include fever, tympanites, pain, distress and dyspnoea. As little as 15 ounces causing death within one to two days.

Distribution: Southern African endemic. South Africa [Northern Cape, Western Cape and Eastern Cape provinces] (fig. 46).

Figure 45. *Pachyacris crispa* var. *pseudocrispa*: a. Whole plant with flowers & fruit showing habit (150mm tall); b. Close up of flowering stems; c. Close up of inflorescence & fruit. d. Coastal grassland in the Eastern Province near Kei Mouth in which populations of *P. crispa* var. *plana* were found. *P. vicaria*: e. Flowering stem. Photographs: a to c by M.H. Giffen; d by A. Nicholas and; e by M. von Fintel.

Key to varieties of *Pachycaris crispa*:

1a Leaves linear-triangular to linear, 4.5 to 8.0mm wide at midway point, base trullate, truncate or rounded, margins crispate or smooth, only midrib prominent 2

1b Leaves oblong, 8 to 20mm wide at midway point, base round to truncate, margins smooth, midrib and secondary veins prominent ..... var. *plana*

2a Leaf margins crispate or undulate, but never revolute ..... var. *crispa*

2b Leaf margins not crispate or undulate, but sometimes revolute ..... var. *pseudocrispa*

Table 10: A comparison of the infraspecific taxa of *Pachyacris crispa* (all measurements in mm)

Character	**Var. *crispa***	**Var. *pseudocrispa***	**Var. *plana***
Stem number	3 to 16	3 to 11	1 to 6
Max. stem height	388	366	366
Leaf shape	Triangular to narrow-triangular	Linear	Oblong to ovate
Leaf apex	Pointed/Acute	Pointed/Acute	Round/Obtuse
Leaf base	Trullate, truncate to round	Round (rarely truncate or trullate)	Rounded (rarely truncate or trullate)
Leaf margins	Crispate	Smooth & revolute	Smooth & flat
Leaf length	36 to 105	28 to 76	20 to 45
Leaf width	4 to 16	4 to 7 (-10)	10 to17
Abaxial leaf venation	Midrib (rarely 2° veins)	Midrib (rarely 2° veins)	Midrib & 2° veins
Phyllotaxy	Spreading erect	Spreading erect	Spreading erect to paten
Peduncle length	20 to 85 (-130)	28 to 64	25 to 50
Inflorescences	Terminal or terminal & axillary. Solitary or paired	Usually terminal, rarely axillary. Usually solitary, sometimes paired	Terminal & solitary
Distribution	Western Cape & Eastern Cape	Eastern Cape	Eastern Cape

9a. *Pachyacris crispa* (Berg.) Nicholas & Goyder variety ***crispa***

Discussion: This species has linear-triangular leaves (the base is much wider that the mid point or apex) with crispate margins. Populations in the Western Cape have a more crispate margin than those in the Eastern Cape. Plants in the Western Cape are found growing in fynbos on sandy soils. This taxon occurs at altitudes of between 30 to 900 meters and flowers between September and Febrary, peaking between November and December.

Distribution: South African endemic [Northern Cape, Western Cape & Eastern Cape provinces] (fig. 46).

Conservation Status: Vunerable in some areas only.

Representative Specimens: South Africa: Eastern Cape: *Hilner 108*, King Williams Town [GRA]; *Mrkokyann 60*, Van Stadens Wild Flower Reserve [GRA]; *Paterson 153*, Van Staadens [GRA]; *Burchell 4412*, Uitenhage [TCD]; *Tyson 2943*, King Williams Town [NBG, PRE]; *Moss 14379*, Port Elizabeth [J]; *Taylor 4951*, Shipton, Martindale [JF, STE]; *Burtt Davy 12014*, The Glen, Humansdorp [PRE fruit]; *Without collector or number*, Knysna [STE 14899]; *Britten 1284*, Hofmans Bosch-field [GRA, PRE]; *Bayliss 5696*, Greyton [PRE]. Northern Cape: *Lewis 6129*, Nieuwoudtville [NBG]; *Walters 174*, Vleikraal [STE]; *Watemeyer ex Marloth 9321*, Pisgoed [PRE]. Western Cape: *Pappe s.n.*, Koeberg [SAM]; *Thode 8397*, Cape Peninsula [STE]; *Acocks 24440*, Redelinghuis [PRE]; *Smith 4766*, between Vandestel & Sir Lowry's Pass [PRE]; *Bachmann 1126*, Hopefield [GRA, PRE]; *Schlechter 9212*, near Paarl [BOL, GRA, PRE]; *Zeyher 1157*, Malmesbury, Klippfontyn [BOL, SAM flowers & fruit]; *Edwards 29*, Porterville [J]; *Barker 10675*, Bok Baai [NBG]; *Wisura 2990*, Kapiteins Kloof near Sauer [NBG]; *Marloth & Stokoe 11578*, Renoster Hills near Wellington [JF, STE]; *Bolus 3312*, near cape Town [BOL, SAM]; *Barker 9610*, Joostemberg farm, Bellville district [NBG]; *Marloth 11578*, Wellington [PRE]; *Hilliard & Burtt 13030*, Darling [NU duplicate in E not seen]; *Barker 6905*, near Gamtoos river [NBG]; *Hugo 618*, Waterboerskraal, Hopefield [JF, PRE, STE with rootstock]; *Compton 17886*, Saldanha [NBG]; *Hall 273*, near Albertina [NBG]; *Purcell s.n.*, Bervliet Farm, Constantia [SAM 90752]; *Smith 4860*, Bonderstel [PRE]; *Esterhuysen 7600*, Bottelary [BOL flowers & fruit].

9b. *Pachyacris crispa* (Berg.) Nicholas & Goyder variety ***pseudocrispa*** (Schltr.) Nicholas & Goyder. *Comb. nov.* **Types:** *Sim 1633*, South Africa, Eastern Cape Province, hills near King Williams Town, Dec. 1893, alt. 1400ft (= 426 meters) [Holo. *n.v.*]; *Saunders s.n. (ex Wood 5380 in Herb Schlechter)*, South Africa, without precise locality [Holo. *n.v.*].

Asclepias crispa L. var. *pseudocrispa* Schltr., in Journ. Bot. 33: 357 [1895]. **Types:** As above.

Discussion: We have not seen the type specimens of *pseudocrispa* cited by Schlechter (1895), but one of the specimens seen by us (*Sim 1634*) has not only been allocated the number following that of one of the types (viz. *Sim 1633*), but has also been collected at the same locality, on the same date (Dec. 1893) and at the same altitude. Variety *pseudocrispa* differs from the typical variety in having linear leaves (same width through out), with smooth but revolute margins and a rounded base. The midpoint leaf width is 4 to 7mm and the average length is shorter (fig. 44). This taxon only occurs at the very eastern range of the species: From about Port Elizabeth to East London (fig. 45). A single specimen (*Bayliss 7881*) of this species has apparently been collected in Lesotho, at an altitude of 2100 meters, but we suspect that the label information is incorrect. Plants are found growing in grasslands at altitudes of about 60 meters, and flowers between October and January.

Distribution: Southern African endemic. South Africa [Eastern Cape province only] (fig. 46).

Conservation Status: Vulnerable in some areas.

Representative Specimens: South Africa: Eastern Cape: *Glass 657*, near Port Alfred [GRA, NH, PRE]; *Glass 278*, Grahamstown [SAM]; *Dyer 4535*, between East London & Peddie [GRA, PRE]; *Galpin 3030*, Port Alfred [PRE]; *MacOwan 721*, near mouth of Kowie River [GRA, TCD]; *Bowker 15*, Kreilis country [TCD]; *Bayliss 4057*, Kasouga [GRA]; *South s.n.*, Port Alfred [GRA, NH, PRE 50172]; *Dyer 455*, between East London & Peddie [GRA]; *Pearson 811*, East London [SAM]; *Daly 821*, near Silbury [GRA]; *Rattray 210*, East London [GRA]; *Compton 232*, west of East London [NBG]; *Maguire 604*, west of East London [NBG]; *Bayliss 4540a*, Southwell [PRE]; *Smith 3848*, East

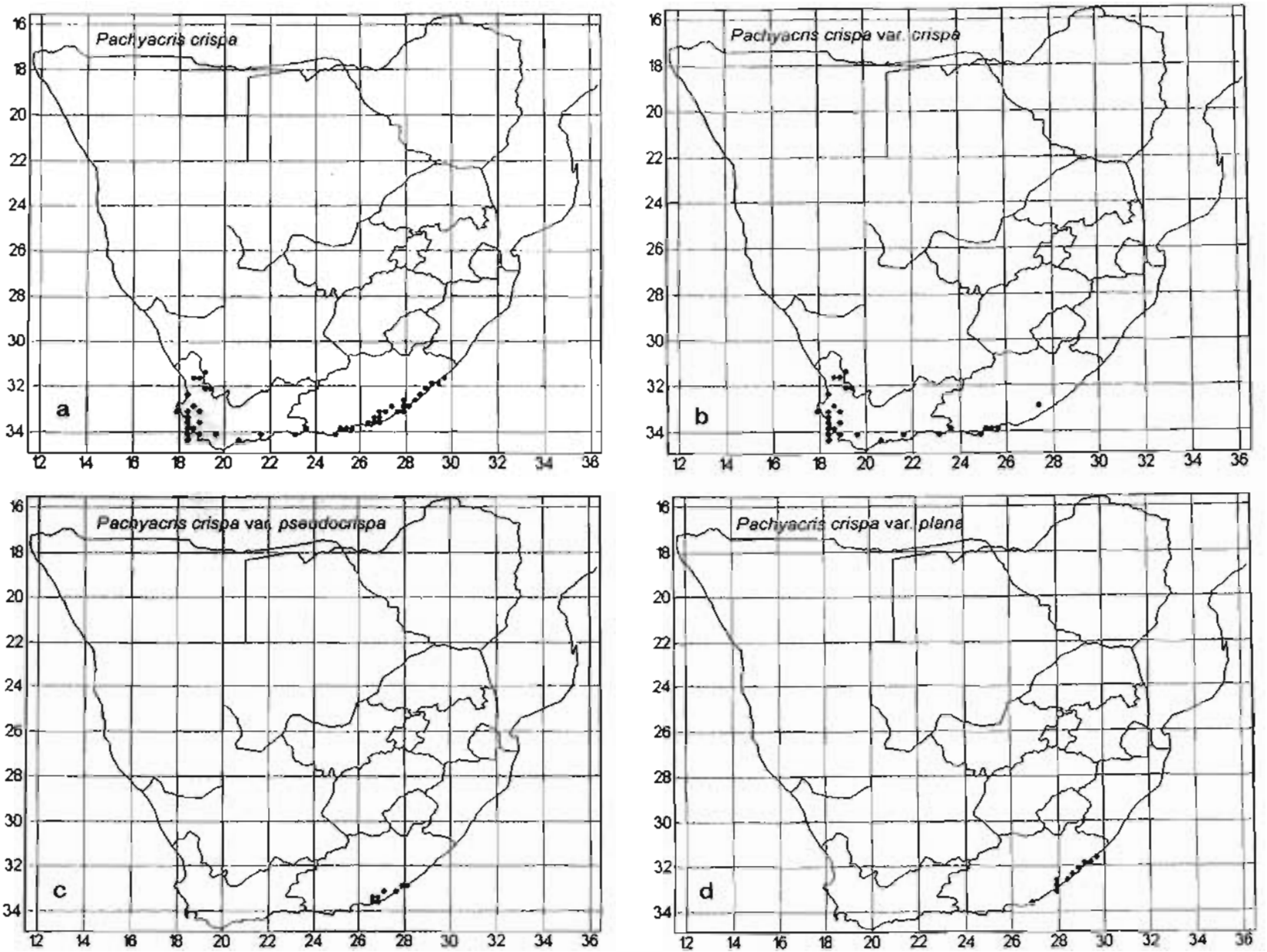


Figure 46. Distribution maps of: a. *Pachyacris crispa* and; *P. crispa*, b. var *crispa*; c. var. *pseudocrispa* and d. var. *plana*.

London [PRE]; *Acocks 10991*, Gonubie Springs [PRE]; *Giffen s.n.*, Kidds Beach [PRE ex UFH 1780]; *Sidney 3144*, Bathurst district [PRE]; *Cloete 2617*, Kap River Reserve, slopes abovbe Fish River [GRA].

Specimens of variety *pseudocrispa* with characteristics of variety *crispa*

Eastern Cape: *Nicholas 2814 with DC Nicholas*, between Coombs & Trappes [UDW]; *Galpin 3253*, East London [GRA]; *Britten 5651*, near the Krowie [GRA]; *Hoskyn 6*, Port Alfred [GRA]; *Bayliss 4540*, Southwell [PRE]; *Acocks 12058*, near Southwell [PRE]; *Daly 584*, Trappes Valley [PRE]; *Bolus 6696*, Round Hill, lower Albany [BOL, PRE]; *de Vos 18381 & 18382*, Alexandria district [STE]; *Letty 150*, Van Staden's Pass [PRE]; *Barker 2855*, East London [NBG]; *Wirminghaus 67*, Round Hill [GRA]; *Compton 17798*, Kidds Beach [NBG]; *Jacques 4951*, Shipton, Martindale [NBG].

Specimens of variety *pseudocrispa* with characteristics of variety *plana*

Eastern Cape: *Giifen s.n.*, Port Alfred [PRE ex UFH 1791A].

9c. *Pachyacris crispa* (Berg.) Nicholas & Goyder variety ***plana*** (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Types:** *Flanagan 103*, South Africa, Eastern Cape Province, near Kei Mouth grassy slopes, Nov. 1889, 200ft (61 meters) [Lecto. PRE. Isolecto. BOL, GRA]. Chosen here. *Hutton s.n.*, South Africa, Eastern Cape province, British Kaffraria [Iso.*n.v.*].

Asclepias crispa L. var. *plana* N.E. Br, in Thiselton-Dyer Fl. Cap. 4(1): 704 [1908]. **Types:** As above.

Gomphocarpus crispus Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 7 non R. Br.

Discussion: This taxon is so morphologically distinct and largely allopatric in distribution from the other two varieties. There is also little evidence of hybridization (only one specimen has been encountered; see under var. *pseudocrispa*). All this indicates that a degree of reproductive isolation is enjoyed by var. *plana* that is not enjoyed by the other varieties. Because of this, a good case could be made for recognizing this taxon at subspecific level, however, for reasons already given we have decided not to persue this option. Originally described by Brown (1908) from only two specimens we have now seen 13 specimens, including one collected by the senior author at the type locality near Kei Mouth. Morphologically var. *plana* differs from var. *crispa* and var. *pseudocripa* in

having fewer stems, leaves oblong, narrowly-oblong to ovate, and wider (8 to 20mm) and shorter (15 to 50mm), the apex is acute while the base is rounded to truncate, both the midrib and secondary veins are clearly visible on the abaxial surface, and the petiole is distinct. In distribution it is largely allopatric, with var. *crispa* and var. *pseudocripsa* occuring from Saldanha and Calvinia in the west to East London in the east while var. *plana* occurs along the coastal belt in what use to be the Transkei (from East London to Coffee Bay). Only one specimen has so far been encountered that is a possible hybrid between *pseudocrispa* and *plana* (*Smith 3786* [PRE]) and this occurs in the small area around East London where the two taxa meet. In the texture and venation of its leaves variety *plana* approaches *P. vicaria*, but it differs considerably from this plant in leaf shape, and larger and differently shaped corona-lobes. Also var. *plana* grows in coastal grasslands while *P. vacaria* grows in midland and highveld grasslands. Plants are found growing in open coastal grasslands (fig. 45) at altitudes of between 15 to 60 meters, and flower between October and March.

Distribution: South African endemic [Eastern Cape province only] (fig. 46).

Conservation Status: Low Risk (Near Threatened).

Representative Specimens: South Africa: Eastern Cape: *Nicholas 2823 with DC Nicholas*, Kei Mouth [UDW]; *Hutchings 314*, Hluleka [KEI]; *Tyson 2*, Coffee Bay [GRA, PRE]; *Codd 6339*, Komgha [PRE]; *Hilner 448*, Qora River Mouth, near Mazeppa Bay [PRE flowers & fruit]; *Gordon-Gray 971*, The Haven [NU]; *Wilman 1075*, Morgans Bay [NBG, PRE]; *Bowker 12*, Kreili's country [TCD]; *Bakelmann 3*, East London [NBG]; *Hilliard & Burtt 11135*, Shelley Beach [NU flower & fruit, duplicates at E, K & MO not seen]; *Hilliard & Burtt 13190*, Potters Pass [NU]; *Mogg s.n.*, Port St. Johns area [PRE 50265, flowers & fruit]; *Acocks 23926*, Gonubie Park [PRE].

10. *Pachyacris flexuosa* (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Type:** *Drége 4965 (V, c),* South Africa, KwaZulu-Natal province, on grassy hills between Umzimkulu and Umkomaas [Holo. B† *n.v.* Iso. P] (fig. 47).

Lagarinthus flexuosus E. Mey., Comm. Pl. Afr. Austr. 207: [1838]. **Type:** As above.

Gomphocarpus flexuosus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias flexuosa (E. Mey.) Schltr., in Journ. Bot., Lond.34: 453 [1894]. **Type:** As above.

Gomphocarpus fragrans Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 30 [1895]. **Type:** *Schlechter 3168,* South Africa, KwaZulu-Natal province, near Pinetown, 12. 09.1893 (Nov. in error), alt. 450ft (= 137m) [Holo.B† *n.v.* Iso. BOL, GRA, PRE].

Discussion: Although similar to *P. multicaulis* this species (fig. 47) differs in having the stems much longer and more laxy, the leaves are linear-triangular (longer and narrower) and usually reflexed downwards. The flowers are also smaller and at sundown they give off a very strong and pleasant scent similar to that of *P. crispa*. *P. flexuosa* also has quite different distribution to *P. multicaulis*. Plants are found growing in sandy soil in open, often annually burned, coastal or midland grasslands that receive good rainfall. They usually appears while the grass is still short. Apparently, they may also be found in hygrophilous grasslands at the edge of moist vleis. Plants occur at altitudes ranging from about 10 to 1500 meters, or occasionally as high as 1800 meters. Flowering takes place from September to December, rarely later. The Zulu, which call this plant *ishongwe elimpofu*, use an infusion of the root as a protective sprinkling charm to ward off lightening (Hutchings, 1996). Illustrated in Nicholas (1981).

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape provinces only] (fig. 48).

Conservation Status: Vunerable in some areas.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 932*, near Midmar Dam [CPF, NH with rootstock, PRE]; *Nicholas 974*, near Ladysmith [NU]; *Nicholas 1022 with Stewart*, Hiddelheim farm, near Hilton College [NU]; *Nicholas 1032*, Howick [NU]; *Nicholas 1024*, near Midmar Dam [NH flowers & fruits]; *Venter 2740*, Empangeni [BLFU]; *Fairall 104*, Cato Ridge [NBG]; *Wood 4937*, Malvern [SAM]; *Weeks 52*, Port Shepstone [J]; *Wood 8269*, Clairmont [NH]; *Gerrard & McKen 514*, near Durban [TCD]; *Ward 4504*, St. Lucia Park [NH, NU, PRE]; *Thode 2881*, Kenterton [JF, STE]; *Rudatis 553*, St Michael [JF, STE]; *Wood 11540*, Clairmont [J]; *Gerstner 23157*, Eshowe [NH, PRE]; *Ward 14477*, New Germany [NH, UDW]; *Thode 2882*, Mid Illovo [JF, STE];

Thode 6414, Glenside, Noodsberg [JF, STE]; *Williams 369*, New Hanover [NH, PRE]; *Krauss 343*, Port Natal (= Durban) [TCD]; *Buthelezi 335*, outside Greytown [NH]; *Sanderson 258*, near Durban [PRE, TCD]; *Wood 5680*, Ingoya [NH]; *Wood 5378*, Howick [BOL, NH]; *Pienaar & Archer 1328*, near Inchanga abiattoir [PRE]; *Weeks 52bis*, Port Shepstone [J]; *Oliver 6769*, Hlimbitwa, Ahrens area [PRE]; *Wood 5582*, Inanda [BOL, PRE]; *Shepherd 10*, Park Rynie [PRE]; *Ward 4332,* Umlalazi Nature Reserve [PRE]. Eastern Cape: *Tyson 2151*, near Clydesdale [NBG, PRE, SAM].

11. *Pachyacris multicaulis* (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Types:** *Drége s.n. (a)*, South Africa, Eastern Cape Province, Schiloh, alt. 3500—4000ft (= 1067—1219m) [Isosyn. PRE 11772]; *Drége s.n. (b. I, a)*, South Africa, Eastern Cape Province, Witbergen, alt. 5000ft (= 1524m) [Syn. *n.v.*].

Lagarinthus multicaulis E. Mey., Comm. Pl. Afr. Austr. 205: [1838]. **Types:** As above.

Gomphocarpus multicaulis (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Types:** As above.

Asclepias multicaulis (E. Mey.) Schltr., in Engl. Bot. Jahrb. 21(5). Beibl. 54: 8 [1896]. **Types:** As above.

Gomphocarpus depressus Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 29 [1895]. **Type:** *Schlechter 3835,* South Africa, Eastern Cape province, Elandspruit moutains, 02.12.1893, alt. 7000ft (= 2134m) [Holo. B† *n.v.*].

Asclepias depressa (Schltr.) Schltr., in Journ. Bot. 455 [1896]. **Type:** As for *Gomphocarpus depressus*.

Discussion: *P. multicaulis* is distinct from almost all other species and is characterised by having many short dichotomusly branched procumbent stems radiating from a narrow cylindical fleshy deep-seated stem-tuber (fig. 47). The leaves are triangular and, often like the stems, crowded and pressed flat against the ground. The inflorescences are the only part of the plant that are held off the ground. The only other species that can be confused with *P. multicaulis* is *P. flexuosa*. *P. multicaulis* is fairly constant in apperance, however, four specimens examined are atypical. *Rademacher 8247* [GRA],

Figure 47. *Pachyacris flexuosa*: a. Inflorescence with close up of flowers; b. Isotype Drege 4965 (P). *P. multicaulis*: c. Whole plant showing habit (200mm tall), note the narrow cylindrical fleshy stem-tuber indicated with an arrow; d. Whole plant showing prostrate spreading habit & habitat (100mm long); e. Flowering stem; f. & g. Close up of flowers showing color variants. Photographs: a to d & f by A. Nicholas; e by W. Menne and; g by P. Cooke.

Ward 1547 [NH] and a specimen without any label [PRE 6968] collected in the north of the distribution range have laxer stems with more sparsely arranged leaves; which are ovate-triangular (sides more rounded) rather than triangular (sides straight). The description of *Steyn 1000* [NBG] collected at Ermelo has leaves more or less sessile so that the opposite leaves sit next to each other on the stem giving the plant a very unusual apperance. The description of *Gomphocarpus depressus* fits exactly *P. multicaulis* and, until the type can be traced and examined, we are treating this name as conspecific with *Pachyacris multicaulis*. The Sotho call this species *lenkiling* and *lekhoaphela*. This latter name means "he who draws his legs together when sitting on the ground" and no doubt refers to the distinct habit of this species with its procumbent compact radiating stems. The Sotho eat the young stems, leaves, flowers and follicles raw or cooked, while the Pondoland Xhosa boil the leaves and add it to other food (Fox & Norwood Young, 1982). Plants are found growing on bare well darined, often sandy, soil in sparse, sometimes annually burned and heavily grazed, grasslands, also sometimes found amongst rocks. *P. multicaulis* occurs at altitudes of between 1200 and 2200 meters, and flowers from October to December, peaking November; although there is one record from February. The flowers apparently give off a honey scented smell. Mogg [3285] records the Zulu name as being *isiKonde*.

Distribution: Southern African endemic. Lesotho and South Africa [Gauteng, Mpumalanga, Free State, KwaZulu-Natal and Eastern Cape provinces] (fig. 48).

Conservation Status: Vunerable.

Representative Specimens: Lesotho: *Dieterlen 116*, Botsabelu [JF, PRE, STE]; *Bayliss 7841*, near Ramas gate [PRE]; *Schmitz 292*, Maseru area [PRE]; *Schmitz 6433*, Roma [PRE]. **South Africa:** Gauteng: *Burtt Davy 11857*, Arcadia, Pretoria [PRE]. Mpumalanga: *Steyn 1000*, Ermelo [NBG]; *Hilliard & Burtt 18507*, near Amersfoort [NU]; *Leenderts 9601*, Bethal [PRE]; *Louw 21*, Ermelo [PRE]; *Rogers 19011*, Volksrust [J, NH]; *Kluge 2660*, Mokobulaan plantation, Skurweberg [PRE]; *Henrici 1076*, Nooitgedacht farm, Ermelo district [PRE]; *Rademacher 8247*, Carolina [GRA]; *Collins 13927*, Piet Retief [PRE]; *Pott 3662*, Bethal [SAM]; *Mathews 1000*, Chrissiemeer [PRE]; *Clarke 1470*, Dullstroom [PRE]; *Beeton 32*, Wakkerstroom [SAM]. Free State: *Venter 3101*, Sterkfontein [PRE flowers & fruits]; *Jacobsz 2074,* Drakensberg Botanic Gardens,

Harrismith (growing wild) [NBG]; *Spies s.n.*, Clocolan [BLFU 7891]; *Moraile 3559*, Lambon's Plantation [BLFU]; *Pont 232*, Kroonstad [BLFU]; *Bruyns 1548*, Golden gate [NBG]; *Pott 3662*, Bethal [GRA]; *Muller 1269*, Sterkfontein Dam area [PRE]; *van Hoepen 10173*, Clarence [PRE very reduced corona]; *Phillips 3206*, near Bethlehem [PRE]; *Pont 444*, Kroonstad [PRE]; Pott 1422, Bloemfontein [BLFU]; *Roberts 2396*, Thaba Nchu mountain [PRE]; *du Preez 1734*, Bloemfontein [PRE]; *van der Zeyde s.n.*, Platberg, Harrismith [NBG 9227]; *Fawkes 29*, Strathcona, Ficksburg [NBG]; *van der Zeyde s.n.*, Witzieshoek [NBG 96853]. KwaZulu-Natal: *Goyder 3938 with Nicholas*, foot of Sani Pass [K]; *Nicholas 930 with G Nicholas*, near Garden Castle [CPF, NH, NU]; *Nicholas 954*, between Estcourt & Colenso [NH, NU fruit]; *Nicholas 974*, between Colenso & Ladysmith by Bergville turn off [NU]; *Nicholas 975*, between Colenso & Ladysmith [NU]; *Nicholas 2039*, Broteni, Mkomazana [NH, PRE]; *Nicholas 2726*, between Midmar & Bulwer [UDW]; *Nicholas 2733 with Poorun*, Sunset Farm, near Underberg [UDW]; *Nicholas 2746 with Poorun*, Sani Pass [UDW]; *Nicholas 2767 with Poorun & Govender*, Loteni [UDW]; *Schlechter 3355*, near Estcourt [BOL, NH]; *Anderson 24*, near Dannhauser [PRE]; *Dyer 3288*, near Underberg [PRE]; *Thode 2772*, Warrock [JF, STE]; *Acocks 9838*, Estcourt Pasture Research Station [NH]; *Stewart 2016*, Ripon Farm, Himeville [NU flowers & fruit]; *Ward 1547*, Hluhluwe game Reserve [NH]; *Scott 264*, Bushman's Pools, Cathedral peak [NH]; *Mogg 3285*, Mooi River [PRE]; *Sidney 3559*, Vryheid [PRE]. Eastern Cape: *Nicholas 2836 with DC Nicholas*, between Dordrecht & Indwe [UDW fruit only]; *Coleman 1016*, Weza [NH]; *Marais 1063*, near Tele on Lundean's Nek road [PRE]; *Hilliard & Burtt 18708*, Yank farm, Ongeluks Nek [NU]; *Hutchinson & Dyer 1818*, near Mount Currie [BOL, PRE]; *Bayliss 7857*, near Mataliele [PRE]; *de Wet 11*, Winterberg, Steynskloof [BLFU]; *Flanagan 1613*, Broughton near Molteno [BOL, SAM]; *Gerstner 161*, Aliwal [PRE very small corona-lobes]; *Boardman 2a*, Ramatsiliso's Gate [PRE]; *Bester 1593*, Wide Valley farm, Maclear [NH]; *Bowker 213*, Kreilis country [TCD]; *Bayliss 7887*, Ida [PRE]; *Granger 3565*, Marshall Clarke, Taba Chitja district [PRE].

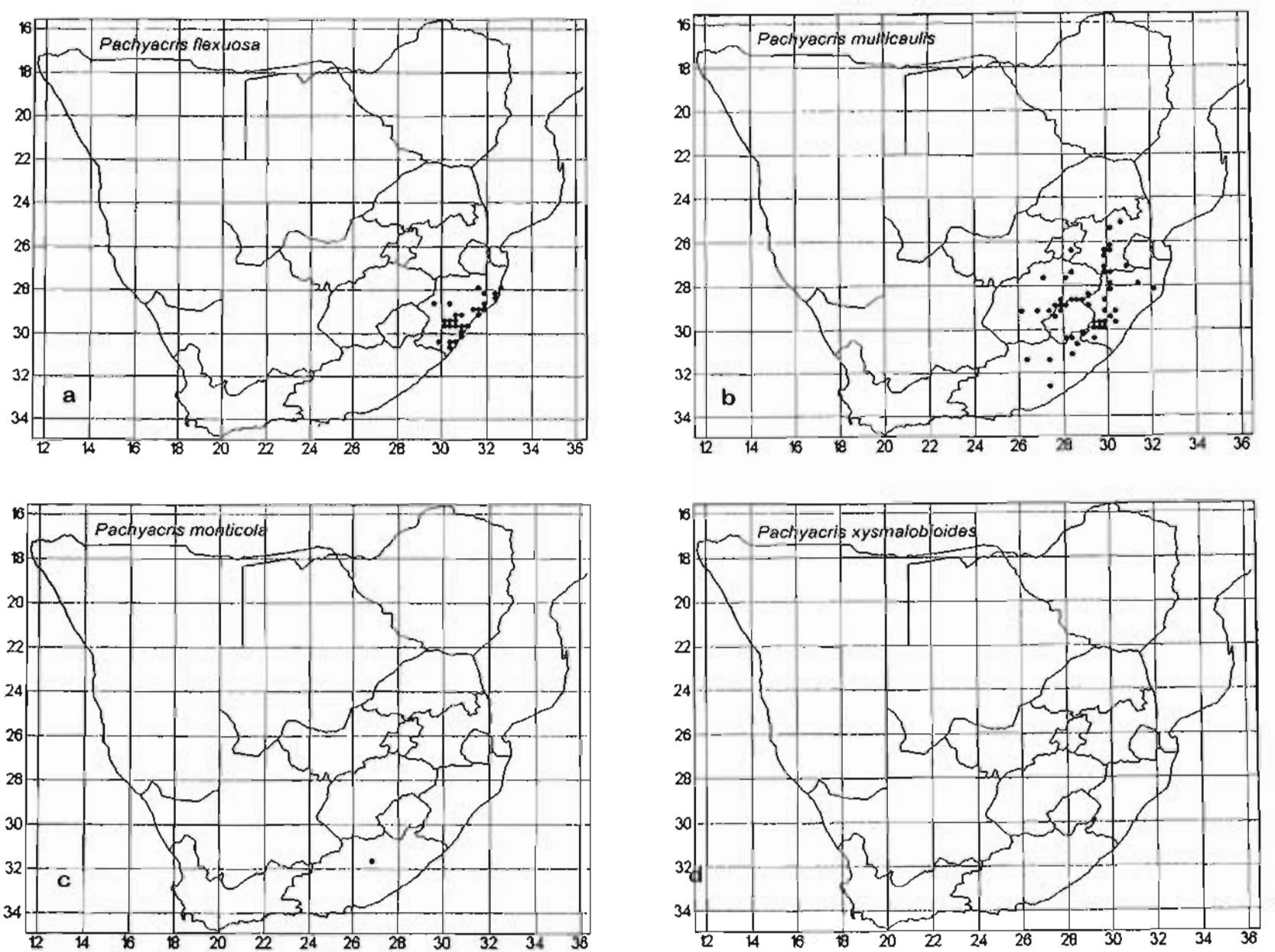


Figure 48. Distribution maps of: a. *Pachyacris flexuosa*; b. *P. multicaulis*; c. *P. monticola* and; d. *P. xysmalobioide*..

12. *Pachyacris monticola* (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 2262,* South Africa, Eastern Cape province, Queenstown District, summit of the Andriesberg Mountains, 6800ft (= 2073m) [Holo. K. Iso. BOL, PRE].

Asclepias monticola N.E. Br., in Thiselton-Dyer, Fl. Cap. 4(1): 700—701 [1908]. **Type:** As above.

Discussion: This species is very similar to *P. xysmalobioides* and differences are discussed under that species. Unfortunately, the only material we have seen of this species is the type and so there is little that we can say about this species. It grows in mountain grasslands at altitudes of about 2000 meters and flowers in summer. *P. monticola* is vegetatively similar to *P. xysmalobioides* and *P. prunelloides* and all three are closely related, also their corona-lobes form a transformational series in which the corona-lobe sinus becomes shallower and then disappears.

Distribution: South African endemic [Eastern Cape province only] (fig. 48).

Conservation Status: Extinct. Known only from the type collected almost 100 years ago.

13. *Pachyacris xysmalobioides* (Hilliard & Burtt) Nicholas & Goyder. *Comb. nov.* **Type:** *Hilliard & Burtt 17342*, South Africa, KwaZulu-Natal, vicinity of Tarn Cave, above Bushman's Nek, 19.01.1984, 2440 meters [Holo. NU. Iso. E, K, PRE, PRF, S].

Asclepias xysmalobioides Hilliard & Burtt, *nom. supf.* in Notes from the Royal Botanic Garden Edinburgh, 43(2): 193—194 [1986], non S. Moore. **Type:** As above.

Discussion: With its small almost obsolete corona-lobe sinus this species represents a transitional state between those species of *Pachyacris* with and those without a hollow corona-lobe. Hilliard and Burtt (1986) mention that *P. xysmalobioides* is similar to *Pachyacris vicaria*, but it actually has much more in common with *P.monticola* and *Pachycaris prunelloides*. In fact, there is very little to tell *P. xysmalobioides* and *P. monticola* apart. Differences and similarities are summarized in table 11.

Table 11: Comparison of *P. monticola, P. xysmalobioides, P. prunelloides, P. rhodantha* & *P. baurii* (all measurements in mm)

Characters	*P. monticola*	*P. xysmalobioides*	*P. rhodantha*	*P. prunelloides*	*P. baurii*
Maximum Stem length	130	200	225	350	150
Leaf shape	Ovate or ovate-lanceolate	Lanceolate	Ovate, lanceolate-ovate	Linear-lanceolate, ovate to elliptic	Lanceolate, ovate to elliptic
Leaf length	12 to 35	10 to 30	11 to 43	11 to 40	18 to 21
Leaf width	6.5 to 14.0	7 to 16	6.8 to 24.0	7 to 21	6 to 9
Leaf base	Subcordate, subtruncate or rounded	Subtruncate to almost round	Rounded, broadly rounded to truncate	Cordate, rounded to broadly tapering	Round to subcordate
Inflorescences position	Usually terminal, rarely lateral as well	Terminal	Terminal	Usually terminal, rarely lateral as well	Terminal
Peduncle length	17 to 38	40 to 70	25 to 46	13 to 140	30 to 70
Pedicel length	11.0 to 13.5	8 to 10	7 to 21	4 to 18	±7
Flower number	6 to 12	20 to 25	7 to 18	12 to 30	20 to 24
Corolla	Reflexed (rotate)	Reflexed (rotate)	Erect (campanulate)	Spreading erect (campanulate)	Spreading (Rotate)
Petal length	±5.5	±4	6 to 8	4 to 7.5	±3
Petal width	±2.8	±2.5	2 to 3	1.5 to 3.0	±1.5
Corona-lobe shape	Subquadrate, not contiguous	Square, not contiguous	Oblong & falcate, not contiguous	Oblong, not contiguous	Orbicular, contiguous
Corona-lobe height	±2.2	±1	2.5 to 5.5	(1.3-) 2 to 2.5	±1.5
Corona-lobe width	±1	±1	1.0 to 1.3	(0.5-) 1	±1.5
Corona-lobe dimension	Ventrally flattened	As broad as wide	As broad as wide	More or less ventrally flattened	Dorso-ventrally flattened
Upper proximal ends	Produced into 2 short falcate teeth which rest on anther-appendages	Obtuse and fleshy and continguous	Absent	Absent	Absent
Upper distal end	Obtusely produced	Obtuse	Obtuse	Obtuse	Obtuse
Corona-lobe sinus	Shallow groove	Very shallow groove - mainly at proximal end (almost solid)	None, solid	None, solid	None, solid
Corona-lobe relationship to style-apex	Level	Corona below style-apex	Level	Level	Level
Flower color	Light green tinged purple	Creamy brown	Purple tinted white	Plum colored tinted yellowish-green	Purple tinted white
Distribution	Eastern Cape near Queenstown	Southern Natal-Lesotho Drakensberg	Eastern Cape	Eastern Cape	Eastern Cape

Compared to *P. monticola, P. xysmalobioides* has slightly smaller flowers and pollinaria, a less stipitate gynostegial-column, corona-lobes square rather than slipper-shaped and abaxial corolla surface pubescent. The two species differ only in degree. Also, some of these characters can be a bit variable, for instance a specimen of *P. xysmalobioides* (*Guillarmod, Getliffe & Mzamane 224*) has corona-lobes that are more slipper-shaped than square, while another specimen (*Bayliss 43*) has the abaxial corolla surface almost glabrous. The two species differ only in degree. However, we are reluctant to sink the two species together because the differences listed above are accompanied by a distinct and quite large geographical separation of the two taxa. A case could be made for treating *P. xysmalobioides* as a subspecies of *P. monticola*, however, we have not opted for this either because there is such little material of both species. *P. xysmalobioides* occurs on the southern Natal Drakensberg summit, where it grows in sparse damp grasslands on poor soils or on steep rocky slopes just below the summit. Plants occur at altitudes of between 1800 and 2500 meters and flower in January. Flowers are sweetly scented. Illustrated in Hilliard and Burtt (1986).

Distribution: Southern African endemic Lesotho and South Africa [KwaZulu-Natal province] (fig. 48).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Although of very restricted distribution this species is largely protected by its very high altitude occurence.

Representative Specimens: Lesotho: *Guillarmod, Getliffe & Mzamane 224*, Sehlabathebe [K, PRE]; *Bayliss 5480*, Sehlabathebe Nature Reserve [PRE]; *Schmitz 7016 & 7036*, Sehlabathebe National Park [PRE]; *Beverly 177*, Sehlabathebe [PRE]. **South Africa:** KwaZulu-Natal: *Beverly 784*, Ngwangwana river canyon [PRE]; *Killick & Vahrmeijer 3967*, Bushmans Nek [PRE].

14. *Pachyacris prunelloides* (Turcz.) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Type:** *Ecklon 41*, South Africa, Eastern Cape province, Winterberg Range, 1500 to 1800 meters [Holo. L *n.v.*, Iso. MEL *fide* Forster (1993), PRE].

Xysmalobium prunelloides Turcz., in Bull. Soc. Mosc. 21(1): 254 (1848). **Type:** As above.

Gomphocarpus prunelloides (Turcz.) Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 35 [1895]. **Type:** As above.

Xysmalobium pedunculatum Harv., Thes. Cap. 2: 8 & t112 [1863]. **Type:** *Barber 82*, South Africa, Eastern Cape province, Winterberg [Holo. TCD. Iso. K].

Gomphocarpus harveyanus Schltr., in Journ. Bot. 33 : 270 [1895]. **Type:** As for *Xysmalobium pedunculatum*. Plus *Galpin 1731*, Katberg, 5000—5500ft (= 1524—1676m) [Isosyn. K, PRE].

Asclepias harveyana (Schltr.) Schltr., in Journ. Bot. 34: 456 [1896]. **Type:** As for *Xysmalobium pedunculatum*.

Discussion: Vegetatively very similar to *P. monticola* and *P. xysmalobioides* but differing from these florally (table 11). The range of variation illustarted by *P. prunelloides* is also larger, but this may be because there is much more material of it collected. In particular, the peduncles and petals may be much longer than in the other two species. More importantly the corona-lobes are quite different being oblong in shape and completely solid, that is without a sinus of any sort. Plants are found growing in midland and upland grassveld, often amongst rocks and in turfy soils. *P. prunelloides* flowers from December to January, and is found at altitudes of between 600 to 2400 meters. Reported by collectors to be common over a century ago, however, a recent collecting trip by the senior author to these older collecting sites failed to turn up any specimens. Illustrated in Harvey (1863) and Langley (1980).

Distribution: South African endemic [Easter Cape province only] (fig. 50).

Conservation Status: Low Risk (Near Threatened). Confined to the Katberg and Amatola mountains, which are now heavily aforested with pine trees.

Representative Specimens: South Africa: Eastern Cape: *Dold 661*, Menziesberg, near Hogsback [GRA]; *Phillipson & Hutchings 97*, Menzieberg [UFH]; *Scully 178*, Katberg [SAM]; *Roux 1200*, near Eliott [NBG]; *Young 15058*, Gaikaskop, Hogsback [J]; *Bester 2027*, Mount Enterprise farm, Maclear [NH]; *Galpin 1731*, Katberg [K, PRE]; *Phillipson 977*, Gaikas' Kop [UFH]; *Furness & Phillipson 355*, Amatole mts west of Tor Doone [UFH]; *Hilliard & Burtt 10921*, Kettlespout falls, Hogsback [NU]; *Rattray 96*, Hogsback

[PRE]; *Compton 19245*, Evelyn Valley [NBG]; *Bester 2112*, Radobil farm, Otto du Plessis pass [NH]; *Sims 1289*, Pirie Plateau, near Franks [PRE]; *Dyer 366*, Katberg [PRE]; *Galpin 837*, Hopewell, Katberg [GRA, PRE]; *Comins 1769*, Fenfield farm, Happy Valley [PRE]; Hilliard & Burtt 18857, Menziesberg [NU];

15. *Pachyacris baurii* (N.E. Br.) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Type:** *Baur 730,* South Africa, Eastern Cape province, near Bazija, Nov., 3500ft (1066 meters) [Holo. K. Iso. SAM].

Xysmalobium baurii N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 580 [1908]. **Type:** As above.

Discussion: Plants slightly more robust, especially stems and flowers, than in *P. monticola*, *P. xysmalobioides* and *P. prunelloides*; which it superficially resembles. It also differs in its dorso-ventrally flattened, orbicular and contiguous corona-lobes. It also differs from *P. prunellodes* in its spreading rather than erect corolla. Plants probably occur in short midland grassveld at altitudes of *cica* 1000 meters and flower in about November. Illustrated in Langley (1980).

Distribution: South African endemic [Easter Cape province only] (fig. 50).

Conservation Status: Extinct. Known only from the type specimen collected almost a hundred years ago. It occurs in a heavily exploited and over populated area of what was the Transkei. Field work undertaken by the senior author in the type locality failed to turn up any asclepiads let alone *P. baurii*; there is little natural vegetation left in the area.

16. *Pachyacris gerrardii* (Scott-Elliot) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Type:** *Gerrard 1289,* South Africa, KwaZulu-Natal province, without precise locality [Lecto. K]. Chosen here. *Gerrard 1951,* South Africa, KwaZulu-Natal province, without precise locality [*n.v.*] *Saunders s.n.*, South Africa, KwaZulu-Natal province, without precise locality [Isosyn. K *n.v.*].

Xysmalobium gerrardii Scott-Elliot, in Journ. Bot.: 364 [1890]. **Types:** As above.

Gomphocarpus ochroleucus Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 30 [1894]. **Type:** *Wood 3398*, South Africa, KwaZulu-Natal province, Gilletts [Holo. B† *n.v.* Iso. K, NH, NU, SAM]

Asclepias ochroleuca (Schltr.) Schltr., Journ. Bot. 34: 455 [1896]. **Type:** As for *Gomphocarpus ochroleucus*.

Asclepias sulphurea Schltr., in Journ. Bot. 34: 454 [1896] non S. Moore, in Journ. Bot.: 312 [1903]. See discussion below.

Discussion: As pointed out by Brown (1908) only two of the specimens cited in the protologue by Scott Elliot (1890) actually belong to this species (*Saunders s.n.* and *Gerrard 1289*) the other *Gerrard 1951* is actually *Pachyacris sulphurea*. *P. gerrardii* can only be confused with *P. tysoniana*, *P. sulphurea* and *P. acerateoides*; see table 12. Like *P. tysoniana* it has yellow colored flowers, but it differs from this species in its more erect rather than procumbent stems, coriaceous leaves with the midrib and secondary veins very prominent, terminal and laterally produced inflorescences (almost always with a terminal and sub terminally inflorescences), peduncles much shorter, and taller but thinner corona-lobes. It differs from *P. sulphurea* by its erect (rather than decumbent) stems, slightly longer and broader leaves, inflorescences produced terminally and laterally forming pairs, corolla erect rather than reflexed and slightly wider corona-lobes.

In 1896 Schlechter combined *Xysmalobium parviflorum* Harv. ex Scott Elliot (= *Pachyacris parviflora*), *Xysmalobium gerrardii* Scott Elliot (= *Pachyacris gerrardii*) and *Gomphocarpus parviflorus* Schltr. (= *Pachyacris sulphurea*) under the name *Asclepias sulphurea* Schltr. (not to be confused with *Asclepias sulphurea* Scott Elliot). As Brown (1908) points out Schlechter seems to have misunderstood the delimitation of these three species. Unfortunately the application of Schlechter's name, *Asclepias sulphurea*, is somewhat confusing as he does not give reasons for his sinking of all these species, a species description or cite specimens.

P. gerrardii is found growing in coastal and midland grassveld, often between rocks, and at altitudes of between 180 and 1500 meters. Flowering occurs from October to January, peaking toward the end of November. Illustrated by Langley (1980).

Distribution: South African endemic [KwaZulu-Natal & Easter Cape provinces] (fig. 50).

Conservation Status: Low Risk (Near Threatened). This species being seldom collected is only known from a hand full of specimens. It occurs in a heavily exploited area.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1706 with Marais*, Weza State Forest [CPF]; *Kunhardt 46 & 109*, Kunhardt's farm near Merrivale [NH]; *Acocks 13235*, Eastwolds, Ixopo district [PRE]; *Gordon-Gray 4522*, Owhilla farm, Karkloof [NU]; *Maurice & Evans 287*, Maxwell, Ixopo [NH]; *Wood 11220*, near Richmond [GRA]; *Rudatis 457*, Friedenau farm, Dumisa [K, PRE]; *Wood 3376*, Botha's Hill near Pinetown [NH with drawing]; *Acocks 13235*, Eastwolds, Ixopo district [PRE]; *Wood 5002*, near Krantzkloof [PRE]; *Wood 3398*, Gillitts [K, NU, SAM]; *Wood 11498*, without precise locality [PRE].. Easter Cape: *Hilliard & Burtt 7539*, Zuurberg, Alfred district [NU]; *Coleman s.n.*, Weza [NU]. Without Precise locality: *Saunders s.n [*K isosyntype], *Saunders s.n* [PRE 14487 probably isosyntype].

17. *Pachyacris tysoniana* (Schltr.) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Types:** *Tyson s.n.*, South Africa, Eastern Cape province, in Malowe Mountains, Dec. 1884 [Lecto. K]. Chosen here. *Haygarth ex Wood 4184*, South Africa, Eastern Cape province, Insikeni, near Kokstad, Dec. 1889 [Isosyn. NH].

Asclepias tysoniana Schltr., Journ. Bot. 33: 358 [1895]. **Type:** As above.

Gomphocarpus tysonianum (Schltr.) Schltr., in Journ. Bot. 33: 271 [1895] in notes only. **Type:** As above.

Xysmalobium tysonianum (Schltr.) N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 579 [1808]. **Type:** As above.

Pachyacris capensis Schltr., in Journ. Bot.: 358 [1895] in notes only. *Nom nud.*

Discussion: This species (fig. 49) is similar in vegetative facie to *P. monticola*, *P. xysmalobioides*, *P. prunelloides* and *P. baurii*, it differs in its yellow or sometimes mauvish yellow colored flowers, erect globose-campanulate and slightly smaller corolla, and oblong solid and contiguous corona-lobes which exceed the style-apex. *Tyson 1748*, housed at Kew, has been annotated by Schlechter as *Pachyacris*. Plants are found growing in short midland, upland or mountainous grasslands, usually in rocky situations,

and at altitudes from 1200 to 2600 meters. Flowers are produced from between October to February, and produce a sweet smell.

Distribution: Southern African endemic. Lesotho and South Africa [KwaZulu-Natal & Easter Cape province only] (fig. 50).

Conservation Status: Low Risk (Least Concern). Seldom collected. Populations are small and scattered, and occur in a heavily exploited region of the subcontinent.

Representative Specimens: Lesotho: *Bayliss 43*, Sehlabathebe Nature Reserve [NBG, PRE]; *Bayliss 5481*, Sehlabathebe Nature Reserve [PRE]; *Beverly 222*, Tsoelikana River valley [PRE]; *Hoener 1913*, Sehlabathebe National Park [PRE]. **South Africa:** KwaZulu-Natal: *Nicholas 2086*, Weza State Forest [PRE]; *MacDevette 1586*, Weza State Forest [PRE]; *Stewart 2092 & 2092A*, Mt. Gilboa, Karkloof [NU]; *Strauss 82*, Ingeli mountain [NBG]; *Strey 6373*, Ingeli mountain [NH, NU]; *Coleman 810*, Ingeli forest [PRE]. Eastern Cape: *Dold 2925 with Cloete & White*, Ntabankulu mountain, Gome Forest Station [GRA]; *Goosens 255*, Mount Currie [PRE]; *Boardman 187*, near Ramatseliso's Gate [PRE]; *Gibson s.n.*, Mount Curry [NU]; *Tyson 1314*, Mount Currie [K specimen seen by Schlechter, PRE, SAM]; *Tyson 1353*, Mount. Currie [PRE]; *Tyson 1784*, Fort Donald [K specimen seen by Schlechter, PRE]; *Brusse 4989,* Kakas Hills, Nungi mts [PRE]; *McLoughlin s.n.*, Mountt. Currie [PRE 51122]; *Taylor 258*, Mt. Currie [NU].

Table 12: Comparison of *P. tysoniana*, *P. gerrardii*, *P. sulphurea, P. acerateoides* and *P. parviflora* (all measurements in mm)

Characters	*P. tysoniana*	*P. gerrardii*	*P. sulphurea*	*P. acerateoides*	*P. parviflora*
Maximum Stem length	150 to 230	300 to 380	150 to 300	380 to 760	120 to 320
Number of stems per plant	Usually near 10 or more than 10	Never more than 10	Never more than 10	Never more than 10	Usually more than 10, sometimes as many as 23
Stem Orientation	Decumbent	More or less erect	Decumbent to almost erect	More or less erect	Decumbent
Leaf shape	Lanceolate, oblong-lanceolate to almost elliptic	Ovate, oblong-lanceolate, elliptic-ovate to suborbicular	Ovate, ovate-lanceolate, to oblong-lanceolate	Ovate, oblong-ovate to lanceolate	Ovate, ovate-lanceolate to lanceolate
Leaf length	35 to 53	30 to 62	10 to 80	40 to 112	(15-) 20 to 45
Leaf width	12 to 20	13 to 27	7 to 22 (-30)	12 to 56	6 to 23

Leaf base	Subcordate, round to broadly tapering	Subcordate to rounded	Rounded to subcordate	Rounded to subcordate	Subcordate, rounded to obtuse
Inflorescence position	Terminal	Terminal & lateral (forming a terminal pair)	Terminal & lateral (2 to 6)	Terminal & lateral (2 to 6)	Terminal &/or Lateral (1 to 4)
Peduncle length	50 to 105	10 to 30	12 to 40 (60)	20 to 50 (70)	10 to 55 (-65)
Pedicel length	5 to 9	5 to 9	5 to 10	5 to 10	4 to 7mm
Flower color	Yellowish, yellowish green, rarely mauvish yellow	Yellow or yellowish	Green tinted purple	Greenish yellow	Pale yellow, greenish white to mauve or purple
Flower number	16 to 20	5 to 20	10 to 27	12 to 24	(7-) 10 to 35
Corolla	Erect (globose campanulate)	Erect (campanulate)	Reflexed	Erect (campanulate)	Erect
Petal length	2.5 to 3.5	3.2 to 4.5	3.0 to 4.8	2.2 to 4.8	2.0 to 3.0
Petal width	1.5 to 2.5	1.5 to 3.0	2.0 to 2.8	1.5 to 2.5 (3.0)	1.0 to 2.0
Petal abaxial surface	Smooth	Smooth	Smooth	With a simple or divided gibbosity	Smooth or occasionally with a small gibbosity
Corona-lobe shape	Oblong, contiguous	Oblong, not contigous	Oblong, not contiguous	Oblong, not contiguous	Oblong to orbicular, not contiguous
Corona-lobe height	±2.3	2.2 to 3.0	1.0 to 2.8	1.0 to 2.4 (3.2)	1.0 to 2.0
Corona-lobe width	±1.5	0.75 to 1.0	1.2 to 1.8	0.7 to 0.9	0.4 to 1.0
Corona-lobe dimension	More or less ventrally flattened	As broad as wide	About as broad as wide	About as broad as wide	About as broad as wide
Upper distal end	Absent	Obtuse	Obtuse	Obtuse	Obtuse
Corona-lobe sinus	None, solid	None, solid	None, solid	None, solid	None, solid
Corona-lobe relationship to style-apex	Corona exceeding style-apex	Corona exceeding style-apex	Corona level with or only slightly exceeding the style-apex	Corona level with or slightly below the level of the style-apex	Corona slightly to much exceeding the style-apex
Corona color	Yellow	Yellow or yellowish	Orange to dull yellow	Yellowish green	Yellow to brown
Distribution	Mostly KwaZulu-Natal, also Eastern Cape	KwaZulu-Natal	Northern, North West, Gauteng, Mpumalanga, KwaZulu-Natal & Swaziland	Mpumalanga, Northern & Swaziland	Northern, North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape & Lesotho.

Figure 49. *Pachyacris tysoniana*: a. Close up of inflorescence; b. Whole plant showing habit & habitat (*circa* 250mm tall). *P. sulphurea*: c. Flowering stem. *P. parviflora*: d. Flowering stems; e. Close up of inflorescence & leaves; f. Flowering stem and; g. Whole plant showing habit (200mm long). Photographs: a by W. Menne; b by A. Abbott; c & f by M. von Fintel and; d, e & g by A. Nicholas.

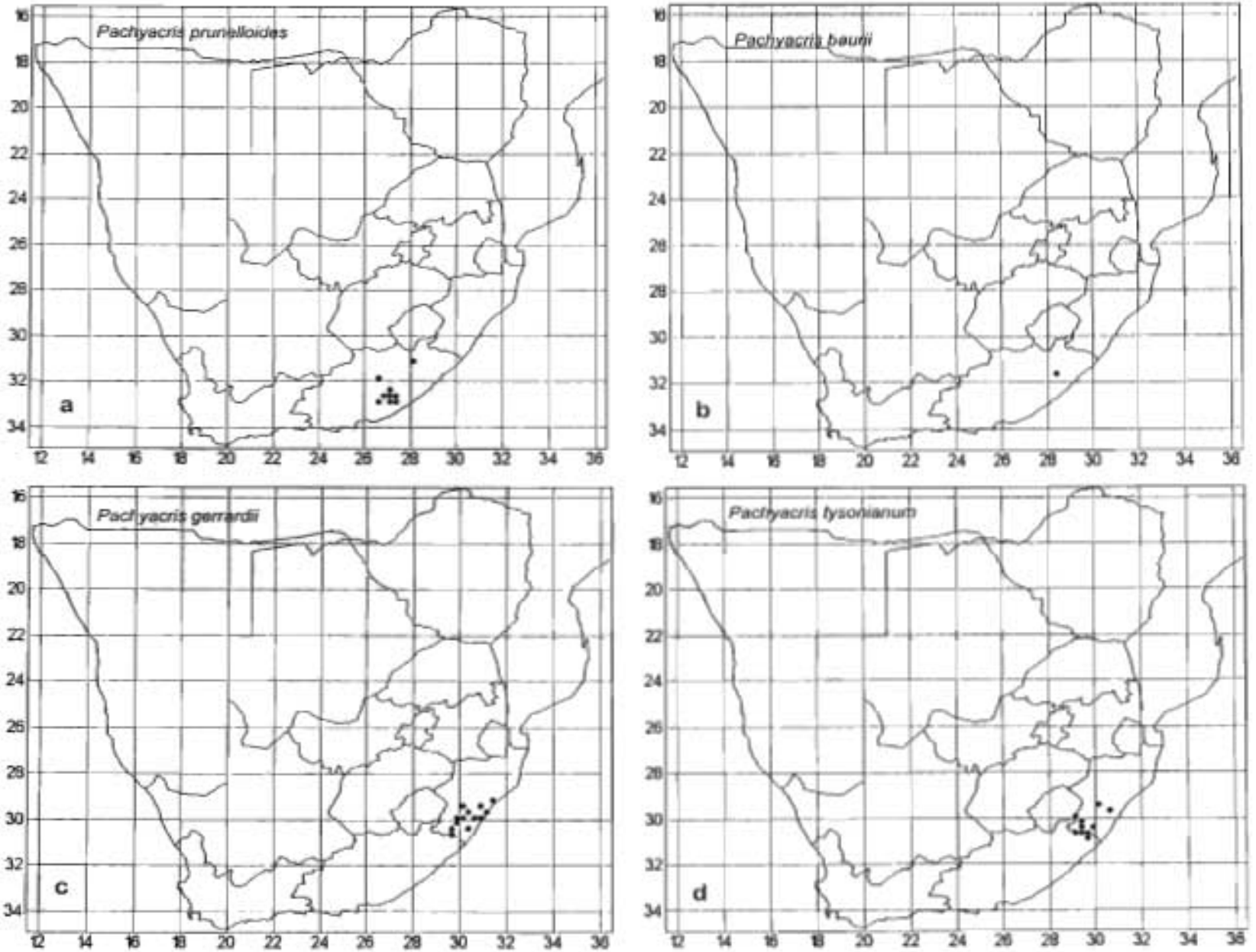


Figure 50. Distribution maps of: a. *Pachyacris prunelloides*; b. *P. baurii*; c. *P. gerrardii* and; d. *P. tysonianum*.

18. *Pachyacris sulphurea* (S. Moore) Nicholas & Goyder. *Comb. nov.* **Types:** *Rand 1046*, South Africa, Gauteng province, near Johannesburg [Holo. *n.v.*]; *Rand 1124*, South Africa, Gauteng province, near Johannesburg [Holo. *n.v.*]

Asclepias sulphurea S. Moore, in Journ. Bot.: 312 [1903] non Schltr., in Journ. Bot. 34: 454 [1896]. **Types:** As above.

Gomphocarpus parviflorus Harv. ex Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 35 [1895] non Harv. ex Scott-Elliot, in Journ. Bot. 28: 368 [1890]. **Type:** *Schlechter 3760*, Burg Spruit. 1530m. 19. Nov. 1893 [Holo. B† *n.v.*, Iso. NH, NU, PRE].

Xysmalobium asperum N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 578—579 [1908]. **Type:** *Burtt Davy 2966*, South Africa, Mpumalanga province, Carolina near Vlakfontein beacon [Lecto. K. Isolecto. PRE]. Chosen here. *McLea ex Bolus 5704*, South Africa, Gauteng province, around Pretoria, 4100ft (= 1250m) [Syn. *n.v.*]; *Conrath 990*, South Africa, Gauteng province, Modderfontein [Syn. *n.v.*]; *Rogers 549*, South Africa, Mpumalanga province, Nelspruit [Syn. GRA]; *Rand 1046*, South Africa, Gauteng province, near Johannesburg [Syn. *n.v.*]; *Rand 1124*, South Africa, Gauteng province, near Johannesburg [Syn. *n.v.*]; *Schlechter 3760*, South Africa, Gauteng province, near Brug Spruit, 4600ft (= 1402m) [Isosyn. NH, NU, PRE]. *Gerrard 1951*, South Africa, KwaZulu-Natal, without precise locality [Isosyn. PRE]; *Bolus 12143*, Swaziland, near Mbabane, 5000—5600ft (= 1524—1706m) [Syn. *n.v.*].

Discussion: This species (fig. 49) can be distinguished from *P. gerrardii* and *P. acerateoides*, with which it is very similar, by its usually decumbent stem, although these may also be erect. Inflorescences are terminal and lateral with between two to six per stem. Flowers have the corolla reflexed (exposing the gynostegial-column), probably the most easily distinguishable feature of this taxon. Corona-lobes are orange to dull yellow and are level with or only slightly exceeding the style-apex. *P. sulphurea* resembles *P. tysoniana* in flower structure, especially color, but not vegetatively. In *P. sulphurea* the leaves are slightly smaller (maximum of 53mm) and ovate to ovate-lanceolate in shape, rather than larger (maximum 80mm) and lanceolate, inflorescences are terminal and lateral rather than just terminal, peduncles are 10 to 40mm (rarely longer) rather than 50 to 105mm, corolla is reflexed rather than erect and the corona-lobes are not contiguous. Schlechter specimens bearing the number 3760 (the type of *Gomphocarpus parviflorus*

Harv. ex Schltr.) seem to have been collected from two different localities, some cite Brugspruit (as mentioned in the protologue) while others cite Wilge River.

Plants are found growing in short grasslands, often produced from between rocks, and occur at altitudes of between 450 and 1800 meters. Flowering occurs from September to January. Illustrated in Langley (1980). Leaves apparently eaten (Peters et al., 1992).

Distribution: Southern African endemic. South Africa [Northern, North West, Gauteng, Mpumalaga & KwaZulu-Natal provinces] and Swaziland (fig. 51).

Conservation Status: Vulnerable in some areas, in particular Gauteng.

Representative Specimens: South Africa: North West: *Bayliss BS4166*, Ventersdorp [PRE]. Gauteng: *Pole Evans H12895*, Kaaffontein [PRE]; *Story 1481*, near Pretoria on Delmas Road [PRE]; *Codd 2217*, near Pretoria [PRE]. Mpumalanga: *Leendertz 7967*, Belfast [PRE]; *Leenderts 2935*, Belfast [GRA]; *van Dam 13713*, Vygeboompoort [PRE]; *Rogers 4760*, Nelspruit [PRE]; *Jenkins 9512*, Middleburg [GRA, PRE]; *Pott 14929*, Spitskop [PRE]. KwaZulu-Natal: *Buthelezi 101*, near Ngome Forest Station [NH]; *Wood 11202*, Nkandhla [GRA, NH, SAM]; *Lawn 1146*, Eshowe [NH]; *Gerstner 2374*, Zululand [PRE]. **Swaziland:** *Compton 27242*, Dalriach, Mbabane [PRE]; *Braun 613*, Malolotja Nature Reserve [PRE]; *Karsten s.n.*, Forbes Reef [PRE 31159]; *Compton 31108*, Top of Komati Pass [PRE]; *Compton 31119*, Dalriach [PRE].

19. *Pachyacris acerateoides* (Schltr.) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Type:** *Galpin 664*, South Africa, Mpumalanga province, Kaap Valley, near Barberton [Holo. B† *n.v.* Iso. K, PRE].

Gomphocarpus acerateoides Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 16 [1894]. **Type:** As above.

Asclepias acerateoides (Schltr.) Schltr., in Journ. Bot.: 454 [1896]. **Type:** As above.

Xysmalobium acerateoides (Schltr.) N.E. Br. in Thiselton-Dyer Fl. Cap. 4(1): 575—576 [1908]. **Type:** As above.

Gomphocarpus ovatus Schltr., in Engl. Bot. Jahrb. 18(45): 20 [1894]. **Type:** *Galpin 674*, South Africa, Mpumalanga province, Saddleback Mountains [Holo. B† *n.v.* Iso. K, PRE].

Asclepias scabridifolia Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As for *Gomphocarpus ovatus*.

Discussion: This plant can be easily confused with *Pachyacris sulphurea* which it resembles vegetatively and with which it shares almost the same distribution. It does, however, have taller stems and larger leaves; see table 12. Dissection of the flower also brings to light substantial differences. The corona-lobes are thinner and may be level or just below the level of the style-apex. However, it is the possession of an erect corolla and a corolline corona (the only other species to exhibit such a corolline gibbosity in the genus *Pachyacris* is *P. parviflora*) that immediately distinguishes this species from *P. sulphurea*. This corolline corona takes the form of two vertical gibbosities separated by a narrow ridge, occasionally this gibbosity maybe undivided and solitary. The corolline corona act as "rails" that guide the pollinating insect's leg or probiscus towards the bottom of the gynostegial-groove. A small gibbosity may sometimes be seen in *P. parviflora* (Langley, 1980), however, this species is distinguished from *P. acerateiodes* by its smaller leaves, purplish pedicels, pale yellow, greenish white to purple colored corolla, smaller flowers and corona-lobes that slightly exceed the bone white style-apex. Plants grow in short open highveld grasslands, at altitudes between 800 and 2280 meters. Flowering occurs from October and January. The leaves are apparently eaten (Peters *et al.*, 1992). Illustrated in Langley (1980).

Distribution: Southern African endemic. South Africa [Northern & Mpumalaga provinces] and Swaziland (fig. 51).

Conservation Status: Vulnerable in many areas.

Representative Specimens: South Africa: Northern: *Pott 4648*, Haenertsburg [PRE]; *Scheepers 816*, Duiwelskloof [PRE]; *Mogg s.n.*, Woodbush [PRE 51117]; *Venter 11104*, Wolkberg [PRE]; *Pott 13840*, Haenertsburg [PRE]. Mpumalanga: *Thorncroft 418*, Ivy Range near Barberton [NH]; *van Steenis* 24177, Mount Sheba [PRE]; *Rogers 18311*, Pilgrims Rest [J]; *Liebenberg 2854*, Schagen Mountain, Barberton [PRE]; *Codd 8104*, near Sewefontein [PRE]; *Barker 10062*, Long Tom Pass [NBG]; *Rogers 2537*, Witbank

[GRA]; *Germishuizen 5672*, Kangwane, Songimvelo Game Reserve [PRE]; *Raal 1013*, Stanley Bush Kop, Graskop [PRE]; *Jacobsen 1771*, Ohrigstad Dam Nature Reserve [PRE]; *Onderstall 900*, Buffelskloof Nature Reserve [PRE]; *Prosser 1941*, near Lydenberg [PRE]; *Retief 113A*, Tienie Louw Nature Reserve [PRE]; *Codd 8104*, near Sewefontein [PRE]; *Onderstall 1284*, Mokobulaan Plantation, Skurweberg [PRE]; *Deall 2486*, Mount Anderson [PRE]; *Galpin 14563*, Graskopspruit [PRE]. **Swaziland:** *Compton 28357*, Bomvu Ridge [NBG, NH, PRE]; *Stewart 9598*, without precise locality [GRA]; *Burtt Davy 2768*, Mbabane [PRE]; *Compton 29380*, Devil's Bridge [PRE]; *Compton 25272*, Ukutula [PRE]; *Compton 28511*, Emlembe [PRE]; *Compton 27223*, Dalriach [PRE]; *Braun 887*, Malolotja Nature Reserve [PRE]; *Karsten s.n.*, Manakaiana [PRE 31157].

20. *Pachyacris parviflora* (Harv. ex Scott-Elliot) Stewart & Langley ex Nicholas & Goyder. *Comb. nov.* **Type:** *Fannin 41*, South Africa, KwaZulu-Natal, Darle Farm [Holo. TCD. Iso. K]

Xysmalobium parviflorum Harv. ex Scott-Elliot, in Journ. Bot.: 363 [1890] non Harv. ex Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 35 [1895]. **Type:** As above.

Gomphocarpus pachyglossus Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 35 [1895]. **Type:** *Schlechter 3493*, South Africa, Gauteng province, Waterfal River, Suikerbossierand [Lecto. K. Isolecto. GRA]. Chosen ehere. *Wood 4370*, South Africa, KwaZulu-Natal province, Weenen county, 08.12.1890, alt. 4000—5000ft (= 1219—1524m) [Isosyn. NH]; *Wood 5126*, South Africa, KwaZulu-Natal province, Kelwin Grove near Glenco [Isosyn. PRE].

Asclepias pachyglossa (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As for *Gomphocarpus pachyglossus*.

Discussion: This species (fig. 49) may be confused with *P. acerateoides* (especially in the north of its distribution) and differences are discussed under this latter species. As pointed out by N.E. Brown (1908), two of the isotypes cited by Scott Elliot (1890) do not belong to this species. *Bolus 5704* is *P. sulphurea* and *Burchell 4151* is apparently too immature for proper identification. In the Eastern Cape this species becomes few

stemmed, laxly branched, few leaved. The leaves are also less coriaceous, being more thinly textured. Inflorescences are fewer and usually in an apical pair. The petals are more spreading, corona-lobes orbicular rather than oblong and much overtopping the style-apex. *Leighton 2673* housed at PRE is a good example of this Eastern Cape form.

Plants are frequently found in large populations in short mountainous grasslands, often amongst rocks or boulders, and in areas that are annually burned or overgrazed. They occur at altitudes of between 900 to 2100 meters. Flowering occurs between October and February, peaking in November, and flowers apparently give off an oaty smell.

Distribution: South African endemic. Lesotho and South Africa [Northern, Gauteng, Free State, Mpumalanga, KwaZulu-Natal and Eastern Cape provinces] (fig. 51).

Conservation Status: Probably not threatened, but vulnerable in some areas.

Representative Specimens: Lesotho: *Dieterlen 473*, Leribe [PRE]; *Stokoe 1550*, without precise locality [PRE]. **South Africa:** Northern: *Rogers 21952*, The Downs [GRA, PRE]; *Venter 1164*, Mt. Lebojane [PRE]; *Venter 11105*, Wolkberg [PRE]; *Stalmans 242*, Lekgalameetse Nature Reserve [PRE]. Gauteng: *Mogg 37480*, Schoongezicht farm, Suikerbosrand [PRE]; *Venter 1164*, Mt. Lebojane, near Tig Beacon [PRE]. Mpumalanga: *Burtt Davy 3888*, Ermelo [PRE]; *Devenish 1193*, Oshoek, Wakkerstroom [PRE with stem-tuber]; *Henrici 1115*, Nooitgedacht farm, Ermelo district [PRE]; *Codd & de Winter 3352*, Graskop [PRE]; *du Toit 28*, Groothoek farm, KwaMandlangampisi [PRE]. Free State: *Venter 7158*, Platberg, Harrismith [BLFU]; *Potts 3092*, Dunelm farm, Fouriesburg [BLFU, PRE]; *Bolus 8112*, near Witzieshoek [GRA, K, PRE]; *Liebenberg 7268*, Gold Gate Hoogland National Park [PRE]; *Zietsman 3139*, QuaQua National Park [PRE]; *Rossouw 511*, Goldon Gate [BLFU flowers & fruit]; *Jacobsz 2976*, Boschhoek [PRE]; *Jacobsz 1371*, Kerkenberg [PRE]; *Flanagan 1853*, Witzieshoek [PRE]; *Potts 3092*, Dunelin farm, Fouriesburg [PRE flowers & fruit]; *van Hoepen 18175*, Clarence [PRE]; *Bolus 2384*, Witzieshoek [NU]. KwaZulu-Natal: *Nicholas 947*, near Mooiriver [NH]; *Nicholas 963*, Giant's Castle Game Reserve [NH]; *Nicholas 1709*, Weza State Forest [NH]; *Nicholas 2753 with Poorun & Govender*, Giant's Castle Game Reserve [UDW]; *Nicholas 2762 with Poorun & Govender*, Kamberg [UDW]; *Nicholas 2840*, Sani Pass [UDW]; *Ngwenya 722*, Ozwatini Plateau [NH];

Schrire 1090, near Ngome Forest Station [NH]; *Buthelezi 338*, near Greytown [NH]; *Langley 11*, Van Reenen [NU]; *Killick 1097*, Cathedral Peak Forestry Station [NH, PRE]; *Edwards 1086*, hill above Dundee Reservoir [NU, PRE]; *Acocks 10680*, Griffen Hill [NH, PRE]; *Thode A199*, Twee Kloo, Altemooi [NH, PRE]; *Killick & Vahrmeier 3656*, Highmoor State Forest [NH, PRE]; *Groenewald 114*, Cobham State Forest [NH]; *Stirton 8177*, between Underberg & Swartberg [PRE]; *Symons 170*, Giant's Castle Game Reserve [PRE]; *Trauseld 425*, Giant's Castle Game Reserve [NU]; *Germishuizen 2394*, near Utrecht [PRE]; *Germishuizen 2109*, Ngome Forest Reserve [PRE]; *Acocks 13854*, Griffin's Hill, Weenen [PRE]; *MacDevette 2040*, Cobham State Forest [PRE]; *Fry 2742*, Greenwich farm, Rietvlei [PRE]. Eastern Cape: *Boardman 9A*, near Ramatsiliso's Gate [PRE]; *Coleman 833*, Glengarry Road [PRE]; *Sim 1289*, Evelyn Valley, King Williams Town [PRE]; *Phillipson & Hutchings 47*, Gaikas's Kop [PRE, UFH]; *Phillipson 1274*, Amatole mts [UFH]; *Sim 1637*, Dohne Hill [NU]; *Theron 2127*, near Stutterheim [PRE specimen not typical]; *Rattray 385*, Hogsback [PRE]; *Bayliss 7846*, near Rama's Gate [PRE]; *Leighton 2673*, Evelyn Valley, near King Williams Town [PRE].

21. *Pachyacris rhodantha* Stewart & Langley ex Nicholas & Goyder. *Sp. nov. P. prunelloides affinis.* ***Herba*** *perennis geophyticus.* ***Radi*** *tuber-caulus profunde infossus, angustus sed carnosus.* ***Caulis*** *3—8, simplex vel 2 ad 3 ramus ad basim prodiens, decumbens, 155—225mm elatus.* ***Folia*** *effusus et adescendens; lamina ovatus vel lanceoltus-ovatus, (11-)15—30(-43)mm longus, (6.8-)1.5—16(-24)mm latus; petioli 2—7mm longus.* ***Inflorescentia*** *umbelliformis, ±hemisphaeris vel cum floris cernuus, diameter 28—38mm; pedunculis 25—46mm longis.* ***Flores*** *7—18 in inflorescentia, rotatis, roseo-vinaceous; pedicellis (7.0-)12.5—21.0mm longis.* ***Corolla*** *erecto-patens, ovatis-oblongis, (6-)7—8mm longis, (2-)2.5—3mm latis.* ***Coronae*** *ad basim prodiens, lobi solidis, carnosis, simplex, ovoideus et falcatis, 2.5—5.5mm longis, 1.0—1.3mm latis, extrinsecis reflexis, malvinus et atropurpureus.* ***Stylus-apicis*** *planus.* ***Typus:*** *Devenish 1069,* South Africa, Mpumalanga province, grassland, 14.11.1963, 6400ft (= 1951m) [Holo. PRE. Iso. K].

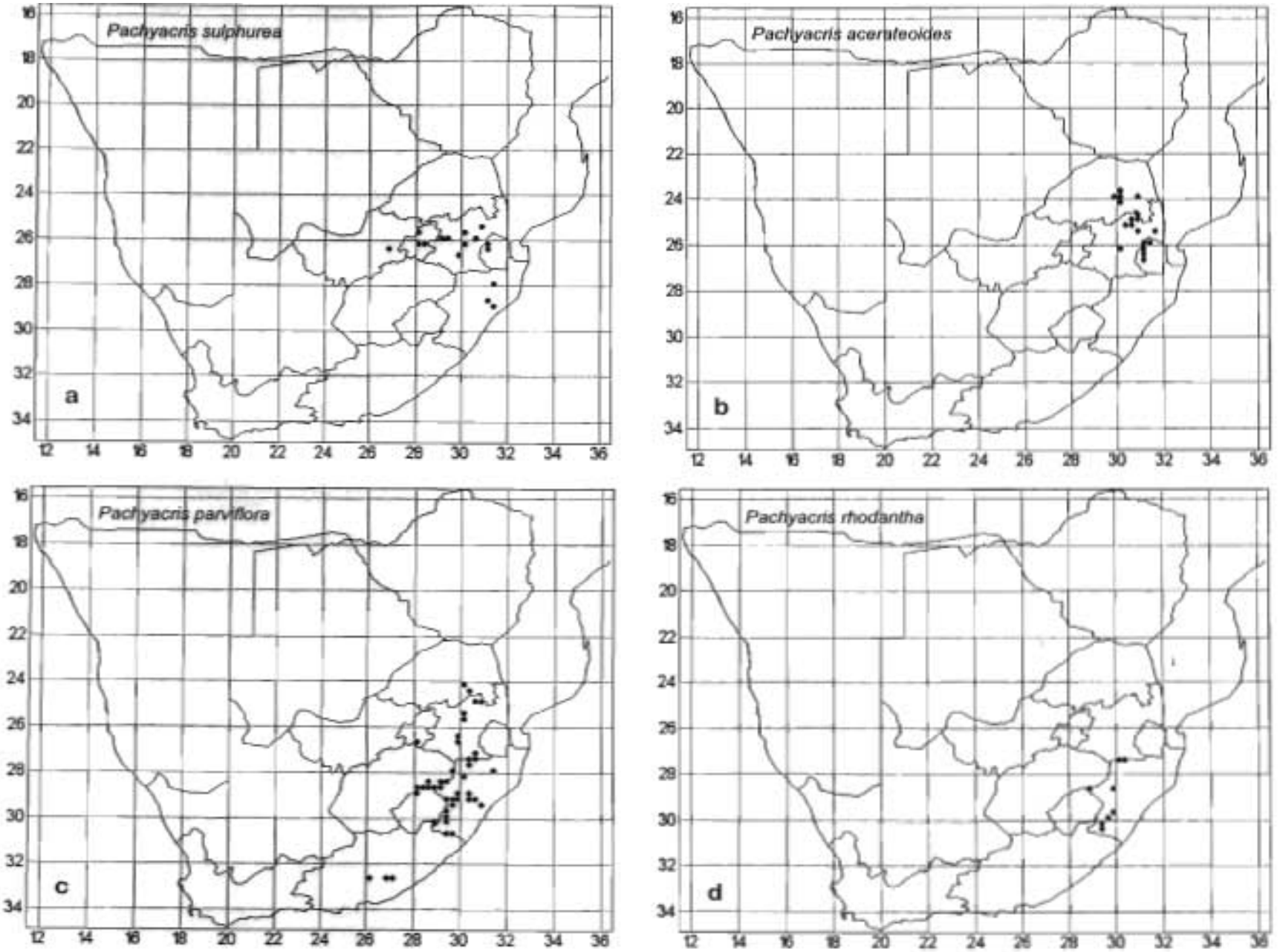


Figure 51. Distribution maps of: a. *Pachyacris sulphurea*; b. *P. acerateoides*; c. *P. parviflora* and; d. *P. rhodantha*.

Description: *Habit*: Perennial, geophytic herb; with milky latex. *Rootstock* a very deep-seated, narrow cylindrical fleshy stem-tuber ±15mm wide. *Stems* 3—8, produced near ground level, simple or 2 to 3 branched near the base, decumbent, 155—225(-310)mm long, pubescent. *Leaves* opposite, simple, entire, spreading to spreading erect; blade young & mature leaves ovate, lanceolate-ovate or broad-lanceolate sometimes oblique, older basal leaves broadly ovate to subtriangular (11-)15—30(-53)mm long, (6.8-) 1.5—16.0(-25.0)mm broad, cuneate, rounded, broadly rounded to truncate, apex acute, margin smooth, abaxial surface with midrib prominent, 2° visible but not prominent, both surfaces sparsely hairy but more so on the abaxial surface; petiole 2.0—8.5mm long. *Inflorescences*: 4—17(-28) per plant, umbell-like, ± hemispherical or drooping, 28—38mm in diameter, usually solitary & terminal, sometimes terminal & lateral, 7—18-flowered; peduncles (8-)25—48mm long; bracts subulate 2.5—5.5mm long. *Flowers* rotate, pinky red, 6—10mm wide, 7.0—8.5mm long; pedicels 7—21mm long. *Calyx* 5-merous; sepals linear-lanceolate, (5.5-)6.0—8.0mm long, (1.0-)1.5—2.8mm wide, apex acute, adaxial surface glabrous, abaxial surface & margins pubescent. *Corolla* 5-merous, suberect to erect; petals ovate-oblong, (6-)7—8mm long, (2-)2.5—3mm wide, adaxial surface glabrous, abaxial surface pubescent. *Staminal-corona* arising at or above the gynostegial column base (so that it appears stipitate), level with to exceeding the style-apex in height with style-apex exposed; lobes solid, fleshy & more of less falcate or scutelliform, curving out from the flower center at right angles to the gynostegial column & sometimes protruding from between erect petals, 2.5—6.0(-8.0)mm tall, 1.0—1.3mm wide, upper distal end blunt, upper proximal ends absent, upper margin broad & convexly arched sometimes shallowly depressed in the center, lareal sides are swollen to produce pollination guide-rails, keel broad & concavely arched, inner surface smooth & flat or sometimes with 2 small dentate wing like proximal appendages that have a narrow groove between them, mauve to dark purple. *Staminal-column*: 2.0—2.5mm tall; anther-wings 0.6—0.75mm long, volcano-like in outline with the access gap at the point furthest from the column and midway along the anther-wing margin; anther-appendages ovate, 0.9—1.0(-1.6)mm long, 1.0—1.4mm wide, apex acute, sometimes obliquely emarginate, inflexed onto & over the style-apex. *Pollinaria:* Pollinia solitary & pendulous in each anther-sac, narrowly ovoid golf-club-like or reniform narrowed for almost ¼ of their

upper end & broad & golf-club shaped below but with outer & inner margins somewhat truncated, 0.3—0.4mm long, ±0.2mm wide; translator-arms attached to pollinia apically, 0.10—0.35mm long; corpusculum ovoid 0.25—0.35mm long, 0.05—0.10mm wide, winged. *Style-apex* 1.5—2.0mm wide, truncated with a central depression. *Fruits & Seeds*: Not seen (fig. 54).

Discussion: *Haygarth ex Wood 12043*, of which there are several duplicates, were all collected at Insekeni, one sheet housed at NH say collected at Entumeni but as this species does not occur in Zululand this specimen has probably received the incorrect labels. *P. rhodantha* is a very pretty species allied to *P. prunelloides*, but differing from it substantially as follows: the corolla is on average slightly larger, the corona-lobes are oblong falcate and reflexed away from the flower center so that they sometimes protrude from between the petals (in *P. prunelloides* they are oblong and erect), corona-lobes are also larger (2.5—5.5mm x 1.0—1.3mm as apposed to 1.3—2.5mm x 0.5—1.0mm), and mauve to dark-purple in color (in *P. prunelloides* they are plum colored tinted yellowish green). There is also a difference in distribution with *P. rhodantha* being found in KwaZulu-Natal in the southern Drakensberg foot hills, midlands, northern Natal and Mpumalanga where it borders northern Natal, while *P. prunelloides* is found some 700 kilometers away in the Eastern Cape centered around the Katberg and Amatola Mountains. This species can be found growing in short, open (apparently well drained) grasslands, often on hill tops and occurs at altitudes of between 600 to 2150 meters. *P. rhodantha* flowers from November to January. Illustrated in Langley (1980).

Distribution: South African endemic [KwaZulu-Natal & Mpumlanga provinces] (fig. 51)

Conservation Status: Low Risk (Near Threatened).

Representative Specimens: South Africa: KwaZulu-Natal: *Haygarth ex Wood 12043,* Insekeni [K, NH]; *Greene 921*, New Forest farm [NH]; *Haygarth s.n.*, Ensikeni [NH 13659]; *Moll 1479*, Runnymead [K, NU, PRE]; *Rennie 232*, Maiwaga, Sunset farm [NU]; *L'ange 16A*, near Witzieshoek [PRE]; *Thode 2580*, Altemooi [STE]. Mpumalanga: *Cameroon 345*, Dullstroom [PRE]; *Drews 109*, Verlorenvallei farm, Dullstrom district [PRE]; *Devenish 243*, Oshoek, Wakkerstroom district [PRE].

22. *Pachyacris hastata* (E. Mey.) Nicholas & Goyder. *Comb. nov.* **Type:** *Drège s.n. (V, b)*, South Africa, Eastern Cape province, between Chalumna River & Buffelrivier, in grasslands, 1500—2000ft (= 458—609m) [Holo. B† *n.v.* Iso. K]

Gomphocarpus hastatus E. Mey., in Comm. Pl. Afr. Austr.: 201 [1838]. **Type:** As above.

Asclepias hastata (E. Mey.) Schltr., in Engl. Bot. Jahrb. 21(5). Beibl. 54: 7 [1894]. **Type:** As above.

Gomphocarpus asclepiaceus Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 7 [1894]. **Type:** *Flanagan 1041*, South Africa, Eastern Cape province, near Komgha, in hilly grasslands, Dec. 1891, alt. 600m. [Holo. B† *n.v.* Iso. BOL, PRE, SAM].

Asclepias flanaganii Schltr., in Journ. Bot. 454: [1896]. **Type:** As for *Gomphocarpus asclepiaceus*.

Gomphocarpus geminatus Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 8 [1894]. **Type:** *Flanagan 391*, South Africa, Eastern Cape province, Kei River valley, in hilly grasslands, Nov. 1890, alt. 600m. [Holo. B† *n.v.* Iso. GRA, NH, PRE, SAM]

Discussion: *P. hastata* is closely allied to *Pachyacris crispa* and some specimens (e.g. *Commins 1352 & Pearson 1506*) resemble this species quite closely and may represent hybrids. *P. hastata* can be distinguished from *P. crispa* by its erect stature, stems stouter and branched (either dichotomously or monopodially) at both the base and higher up, hastate leaves and differently shaped corona-lobes (with distal appendages larger and erect). One specimen (*Batten 107*) has leaves similar to *P. cooperi* and may be a hybrid between these species, while another (*Smith 3743*) maybe a hybrid between *P. hastata* and *P. crispa* var. *pseudocrispa*. Differences between these two species are discussed under *P. cooperi*. Plants are found growing in open, often annually burned, midland grassveld and occur at altitudes of between about 400 and 600 meters. The flowering period is very short, from November to December; peaking in November.

Distribution: South African endemic [Eastern Cape province only] (fig. 52).

Conservation Status: Vulnerable. Seldom collected nowdays. Occuring in a small area that is heavily exploited and over populated.

Representative Specimens: Botswana: South Africa: Eastern Cape: *Dold 657*, Menziesberg, near Hogsback [GRA]; *Batten 107*, Komga [PRE]; *Sim 1565*, King Williams Town [PRE, SAM]; *Bowker 295*, Kreilis country [TCD]; *Brownlee s.n.*, King Williams Town [TCD]; *Krook 815*, near Kei River [K]; *Tyson 2910*, King Williams Town [SAM]; *Pearson 1506*, East London [SAM]; *Commins 1352*, near Macleantown [GRA a mixed collection with *P. crispa* var. *pseudocrispa*]; *Compton 17763*, Mooiplaats [NBG]; *D'Urban 70*, King Williams Town [TCD]; *Hutton s.n.*, without precise locality [K]; *Dyer 4524*, Kabusie River Valley, near Komgha [PRE]; *Smith 3743*, Nahoon Valley [PRE].

23. *Pachyacris sp. nov. b*

Discussion: This species resembles *P. woodii* in habit, consisting of a single erect stem over 500mm tall. However, it differs from this species in almost all of its other features. The stem bears 11 pairs of narrow-lanceolate leaves, which can get quite large (up to 100mm long & 18mm wide) and have a prominent midrib with secondary veins hinoideus. The inflorescence is umbelliform, flat topped and terminal on a short peduncle (46mm). Flowers are about 10 per inflorescence and have the corolla reflexed and brownish in color. The corona-lobes are turriform (greatly overtopping the style-apex) and have a narrow channel-like sinus down the inner surface. They are pink colored. The anther-wings have a notch, midway along their length, as is found in the genus *Bruynsia*. Plants apparently grow amongst grass on granit kopjies and flower in February. This specimen surfaced too late in our study to be named here, this will be done at a later date.

Distribution: South African endemic [KwaZulu-Natal province only] (fig. 52).

Conservation Status: Endangered. Only known from one specimen collected 30 years ago. This unnamed species is found in an area that is heavily utilized for agriculture.

Representative Specimen: South Africa: KwaZulu-Natal: *Strey 8027,* near Grootspruit, Vryheid district [NH].

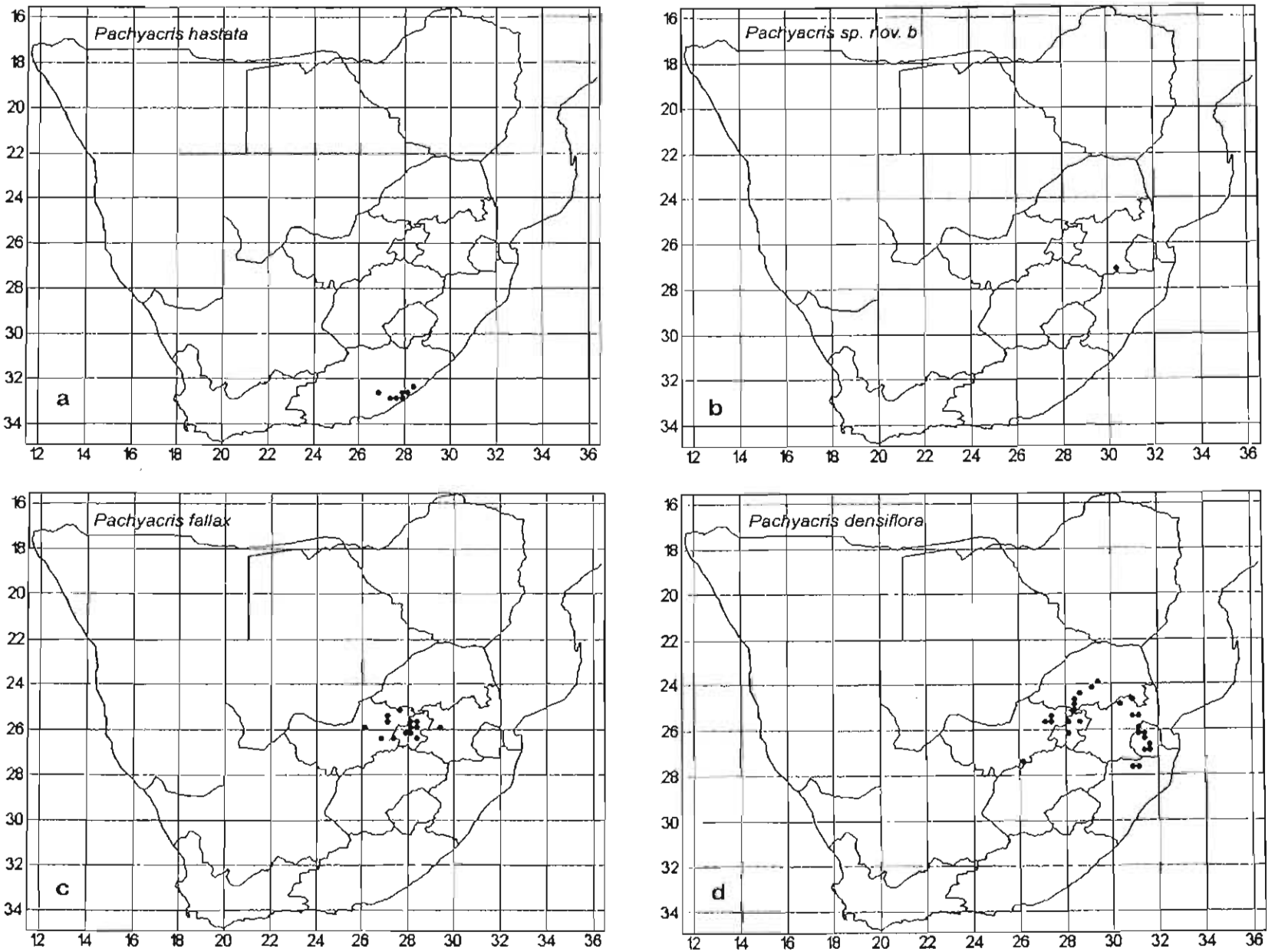


Figure 52. Distribution maps of: a. *Pachyacris hastata*; b. *Pachyacris sp. nov. b*; c. *P. fallax* and; d. *P. densiflora*.

24. *Pachyacris fallax* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Schlechter 3604*, South Africa, Gauteng province, near Pretoria, 01.11.1893, 5000ft (=1524 meters) [Holo. B† n.v. Iso. BOL]

Gomphocarpus fallax Schltr., in Engl. Bot. Jahrb. 20(5). Beibl. 51: 29 [1895]. **Type:** As above.

Asclepias fallax (Schltr.) Schltr., in Journ. Bot.: 455 [1896]. **Type:** As above.

Discussion: *P. fallax* is similar to *P. densiflora* but differs from this species in its shorter stature, differently shaped shorter leaves, shorter peduncles, fewer flowered inflorescences and differently colored corona-lobes; see table 13. This species is found growing in grassy situations, on stony ground (a habitat known as klipveld), usually but not always in unburned situations. Plants occur at altitudes of between 1200 and 1800 meters and flower from September to January, peaking September to November. Pollinia illustrated in Schill & Jakel (1978).

Distribution: South African endemic [North West & Gauteng provinces] (fig. 52).

Conservation Status: Low Risk (Least Concern). This species occurs mostly in the Gauteng province, which is probably the most urbanized, industrialized and agriculturally abused in South Africa. It is, thus, not surprising that although once commonly collected in the earlier part of the century it has seldom been collected since the 1960s (fig. 53).

Representative Specimens: South Africa: North West: *Leendertz 9588*, Rustenburg [PRE flowers & fruit]; *Mogg 22300*, 13 miles north of Ventersdorp [J]; *Pegler 980*, Rustenburg [SAM]; *Rogers 23525*, Rustenburg [J]; *Sutton 314*, Grarsfontein [PRE]. Gauteng: *Smith 3345*, Hillcrest, Pretoria [PRE fruits]; *Bruce 216*, near Pretoria [PRE]; *Acocks 20875*, near Monsterlus [PRE]; *Leenderts 294*, Pretoria [GRA]; *Fairall 1581*, Waterkloof [NBG]; *Watt 151/6777*, Fountains Valley [J]; *Moss 106121*, Pretoria [J]; *Moss 10479*, Rooderpoort [J]; *Smutts & Gillett 3040*, Doornkloof [JF, PRE, STE flowers & fruit]; *Fabian 1192*, Sandton, Morningside Manor [PRE]; *Thode A1320*, Heidelberg [NH]; *Mogg 34537*, Isaac Stegmann Nature Reserve [J]; *Leendertz 4356*, Pretoria [SAM]; *Neetling s.n.*, Pretoria [STE 11703]; *Smith 836*, Riviera [PRE]; *Leemann s.n.*, Rietondale [PRE]; *Goosen 58*, Muckeneuk [PRE]; *Leendertz 9501*, Heidelberg [PRE]; *Pole-Evans 143*, Curtis Hill, Pretoria [PRE]; *Phillips 530*, Blyvooruitzicht [PRE]; *Pole-Evans s.n.*,

between Irene & Lyttelton [PRE flowers & Fruit]. Mpumalanga: *Young 32456*, Middelburg [PRE].

Table 13: List of differences between *P. fallax* and *P. densiflora* (all measurements in mm)

Characters	*P. fallax*	*P. densiflora*
Stem height	120 to 410	240 to 540
Lower internodes	6 to 22	21 to 42
Leaf shape	Triangular to lanceolate	Ovate, ovate-oblong to linear-lanceolate
Leaf apex	Acute	Pointed to acute to subobtuse
Leaf base	Trullate, cuneate-hastate to subtruncate	Cordate, subcordate, subtruncate to round
Leaf length	10 to 70	21 to 67
Leaf width at base	(6-) 10 to 34	(2.8-) 4.5 to 22.5
Peduncle length	38 to 200	60 to 240
Inflorescence diameter	20 to 35	22 to 40
Flower number	12 to 15 (-28)	(12-) 15 to 25
Petal length	4.5 to 5.5	5.5 to 6.8
Petal width	3.0 to 3.5	3.0 to 4.0
Abaxial petal color	Creamy	White, cream or pale yellow
Corona-lobe length	2.8 to 3.0	2.5 to 3.0
Corona-lobe color	Creamy to pale greenish-yellow above, purple-brown below & on the keel	Usually uniformly yellow, rarely uniformly white
Follicle length	70 to 82	56 to 68
Altitude	1200 to 1800 meters	600 to 1500 meters
Flowering time	September to January	October to February
Distribution	South Africa (North West & Gauteng provinces)	South Africa (Northern, North West, Gauteng, Mpumalanga & KwaZulu-Natal provinces), Swaziland & Zimbabwe

25. *Pachyacris densiflora* (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Type:** *Cecil 78*, Zimbabwe, between Harare and Bulawayo [Holo. K].

Asclepias densiflora N.E. Br., in Thiselton-Dyer Fl. Trop. Afr. 4(1): 320 [1902]. **Type:** As above.

Discussion: Although similar to *P. fallax*, this species is larger in stature with longer internodes at the stem base, a greater range in leaf size and shape, inflorescences larger in diameter and with a greater number of larger sized flowers, and differently colored

corona-lobes. *P. densiflora* is also more widely distributed and, not surprsingly because of this, occurs at a wider range of altitudes and has a longer flowering period. Interestingly, despite the fact that it is more widely distributed it has generally not been much more collected than *P. fallax*. This species can be found growing in stony grassveld, savanna or in open grassy woodlands or bushveld (such as open *Faurea* woodland with sour grasses or *Pterocarpus* woodlands), usually occuring in sandy, well-drained soils. Plants occur at altitudes of between 570 and 1500 meters and flower from October to February. Flowers apparently smell of vanilla. According to Fox & Norwood Young (1982) the Swati name for this plant is *umdayi* or *umdzayi* and the Shangaan name is *xihaja*. Apparently in the Sekukuniland area the leaves are cooked with a little water and seasoned with salt after which it is used, despite its very bitter taste, as a relish for other foods. This species only just gets into KwaZulu-Natal (so far only being collected at Itala Game Reserve) where it boarders Mpumalanga province. This is the only member of the genus *Pachyacris* to occur outside of southern Africa.

Distribution: South Central African endemic. Southern Africa in South Africa [Northern, North West, Gauteng, Mapumalaga and KwaZulu-Natal provinces] and Swaziland (fig. 52). Also in Zimbabwe.

Conservation Status: Vunerable.

Representative Specimens: South Africa: Northern: *Leendertz 4358*, Warmbaths [SAM]; *Leenderts 1581*, Warmbaths [BOL, GRA]; *Hardy 6146*, Steelpoort [PRE]; *Galpin 19212*, Mosdene, Naboomspruit [PRE]; *Thode A1734*, Warmbaths [NH, PRE]; *Burtt Davy 2221*, Warm Baths [NH, PRE fruit only]; *Thorncroft 211*, near Barberton [NH]; *Galpin 6473*, Nylstroom [GRA]; *Maguire 1402*, Potgietersrust [NBG fruit only]; *Pole Evans H16894*, Hammanskraal [PRE]; *Bredenkamp & van Vuuren 191*, Pietersburg Nature Reserve [PRE]. North West: *Thode 2885*, Rustenburg [JF, STE]. Gauteng: *Nunns 13035*, Volhuter's Kop [PRE]; *Moss 10638*, Parktown [J]; *McLea 5706*, near Pretoria [SAM]; *Rogers 25037*, Premier Mine [PRE]; *Pole Evans s.n.*, between Hebron & de Wildt [PRE 50211]. Mpumalanga: *Rudatis 20012*, Buffelsvlei [STE]; *Codd 5681*, Kruger Game Reserve, Pretorius Kop Camp [PRE]; *Acocks 16616*, near Machadodorp [PRE]; *Rogers 23291*, White River [J]; *Hardy 6146*, near Steelpoort [PRE]; *van der Schiff 288*,

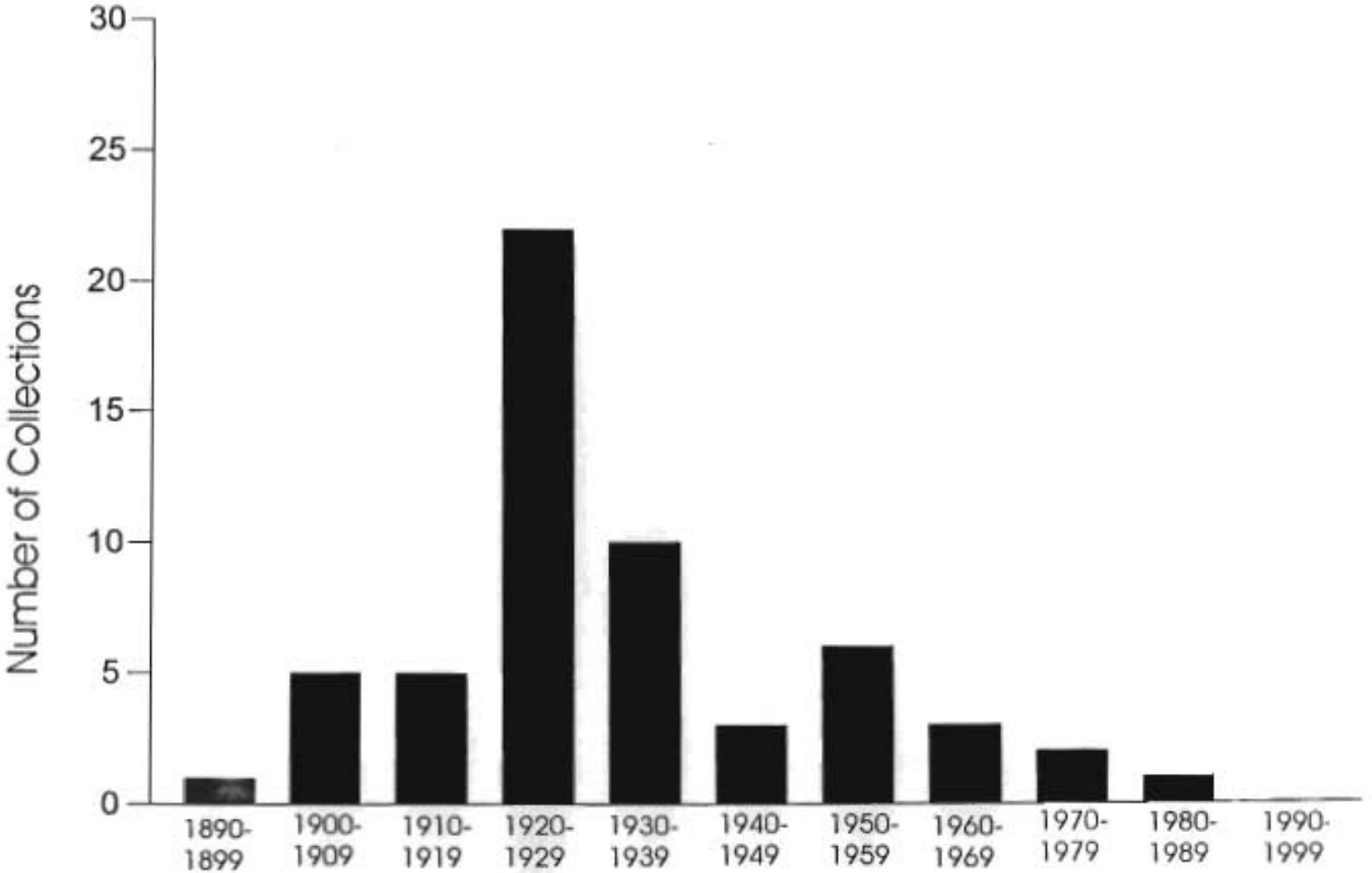


Figure 53. Histogram of herbarium collections made of *Pachyacris fallax* over the past hundred years. Note the overall decline of this species and the fact that it has not been collected during the last decade. This graph reflects the fact that this species is now endangered in the wild. A similar trend can, unfortunately, be illustrated for many Asclepiadaceae and a number, species are already extinct. Notice also a decrease in collecting rates during the Second World War.

Figure 54. *Pachyacris rhodantha*: a. Whole plant showing habit & habitat (*circa* 300mm tall); b. Inflorescence. *P. woodii*: c. Whole plant showing habit (1m tall); d1. Lecotype Wood 4258 (housed at NH); d2. Enlargment of drawing on type done by Millicent Franks; e & f. Close up of paired inflorescences and; g. Close up of flowers. Photographs: a & b by L. Greene and; c, d, e, f & g by A. Nicholas.

Pretorius Kop area, Kruger National Park [PRE]; *Jenkins 6964*, Beestkraal [PRE]; *Pott 5364*, Barberton [PRE]; *Venter 12698*, Klaserie [PRE]; *Leach 13177*, near Nelspruit [PRE]. KwaZulu-Natal: *McDonald 275*, Itala Nature Reserve [NU]; *Harriss 152*, Itala Game Reserve [NU]; *Nichols 701*, Itala Game Reserve [NH]. **Swaziland:** *Compton 31054*, Komati Pass [NBG]; *Braun 1842*, Nkomati River Valley [PRE]; *Germishuizen 7106*, Nkomati River Valley [PRE sheet 1 fruit only, sheet 2 flowers only]; *Hobson 2150*, near Nyokane by Enkab trig beacon [PRE flowers & fruit]; *Dlamini s.n.*, Bulunga Poort [PRE 31209]; *Compton 26407*, near Kubuta [PRE]; *Bolus 12141*, Mafutane [BOL]. **Zimbabwe:** *Chase 7413*, Umtali [NU]; *Norlindht & Weimarck 2819*, near Inyazura [PRE]; *Eyles & Johnson 1156*, Bulawayo [GRA]; *Eyles 2021*, Macheke [SAM].

26. *Pachyacris sp. nov. c*

Discussion: This species (fig. 55) is florally similar to *P. densiflora*, but quite distinct vegetatively. Stems are erect, sparsely branched (side branches shorter) and ±370mm tall. Lower internodes are about 18mm long. Leaves linear, 30—62mm long, 1.5—4mm wide, with the base shortly triangular to cuneate. Peduncles are 98—165mm long, with terminal inflorescences hemispherical, between 23—34mm in diameter and bearing about 15 flowers. Plants apparently occur in grassland on sandy soils. The only specimen so far seen occured in a badly erroded donga. Plants occur at altitudes of about 1000 meters and flower in November. We have not been able to name this taxon because the only specimen we have seen is in private hands and not housed in an accredited research institute.

Distribution: South African endemic [Northern province only] (fig. 55).

Conservation Status: Critically Endangered.

Representative Specimens: South Africa: Northern: *Kritzinger 110*, Maandagshoek, Sekhukhuneland [Specimen in hands of collector. Photocopy at PRE].

27. *Pachyacris cooperi* (N.E. Br.) Nicholas & Goyder. *Comb. nov.* **Type:** *Cooper 473*, South Africa, Eastern Cape province, Kat River valley [Lecto. K. Iso. TCD] (fig. 55).

Cooper 159, South Africa, Eastern Cape province [Isosyn. TCD] (fig. 54); *Bowker 96*, South Africa, Eastern Cape province, Kreilis country [Isosyn. TCD] (fig. 54); *Barber 80*, South Africa, Eastern Cape province, top of high hills above Waterkloof & at Kaal Neck near the Winterberg [*n.v.*]; *Scully 121*, South Africa, Eastern Cape province, Stockenstrom division, Lushington Mountain [*n.v.*].

Asclepias cooperi N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 707 [1908]. **Type:** As above.

Discussion: *P. cooperi* is similar to *P. fallax*, *P. densiflora* and *P. woodii* in the nature of its corona-lobe, habit and fruit structure. These four species are usually few branched (1 to 4, rarely more), with the stems erect and often very tall, large lanceolate leaves (generally with midrib and secondary veins prominent), and usually very long peduncles. The corona-lobes are claw-like, fleshy, overtop the style-apex and invariably yellow or bright yellow in color. Fruits are lanceoloid, thick and with five to six short irregularly thickened or regulary and conically toothed longitudinal ridges. Both *P. crassinervis* and *P. meliodora* have a similar habit but possess shorter peduncles and quite differently structured corona-lobes. *P. cooperi* differs from its nearest allies by its slightly crispate leaves, shorter peduncles (56 to 126mm), larger inflorescences (36 to 56mm) with up to 50 flowers and its Eastern Cape distribution. Plants are found growing in mountain grasslands, according to one label in sourveld, and occur at altitudes of between 650 and 1400 meters. *P. cooperi* has flowers with a greenish-yellow corolla and bright golden yellow corona. These are produced between November and January, with one record from April.

Distribution: South African endemic [Eastern Cape province only] (fig. 56).

Conservation Status: Critically Endangered. The mountains in the Eastern Cape, where this species occurs, has a few reserved nature areas, however, the majority of land is now under plantation or agriculture. Despite the fact that this area has been extensively collected in mordern times we have seen no specimens of *P. cooperi* from this area collected after the 1960s.

Representative Specimens: Botswana: South Africa: Eastern Cape: *Barker 1427 & 1428*, Hogsback [NBG]; *Moss 15057*, Hogsback [SAM]; *Theron 2122*, Stutterheim district [PRE]; *Galpin 8242*, near Kei Road Station [PRE]; *Ackins 56*, near Amabele

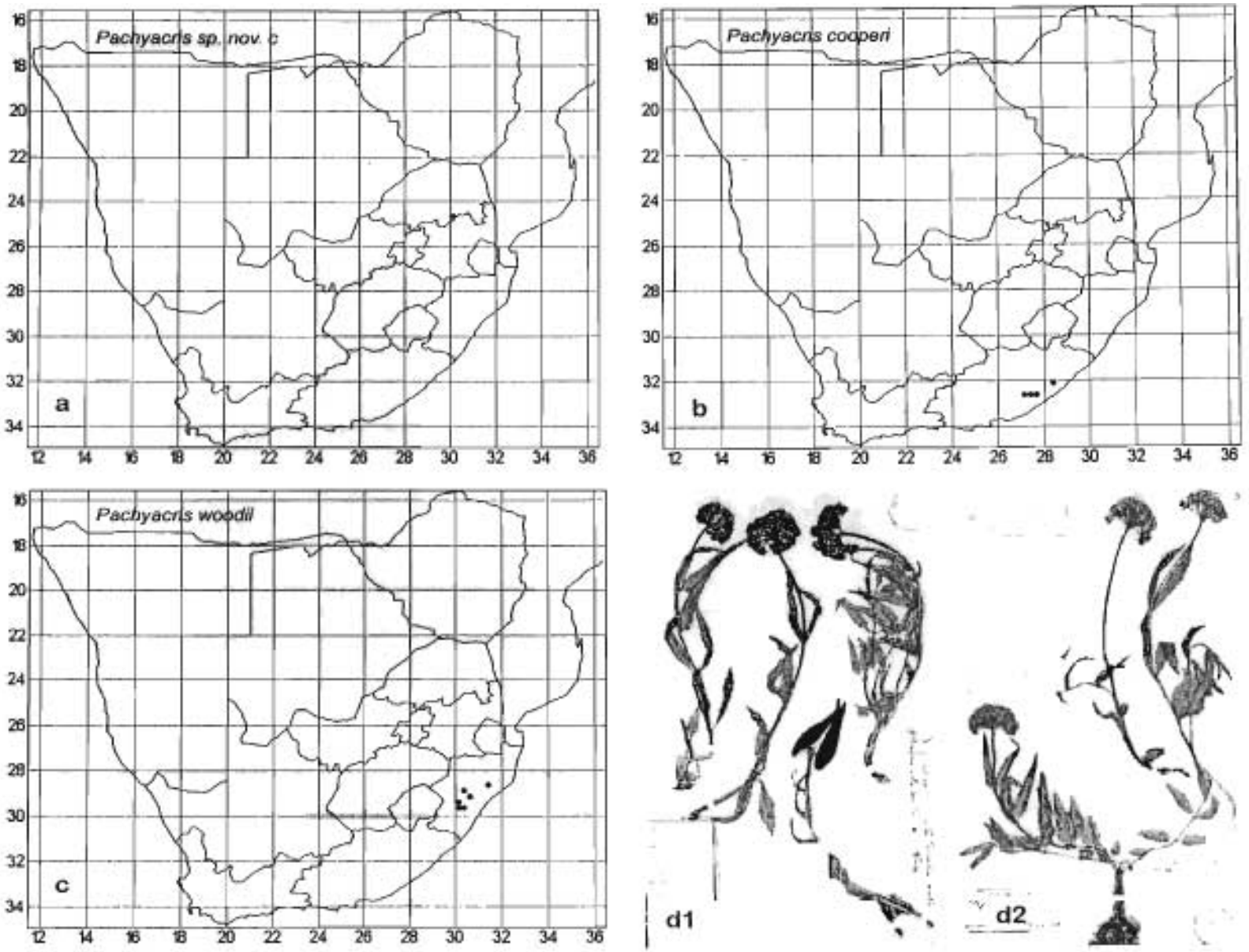


Figure 55. Distribution maps of: a. *Pachyacris sp. nov. c*; b. *P. cooperi* and; c. *P. woodii*. *P. cooperi*: d1. Bowker 96 (TCD) and; d2. Isolectotype Cooper 473 & Isosyntype Cooper 159 (TCD).

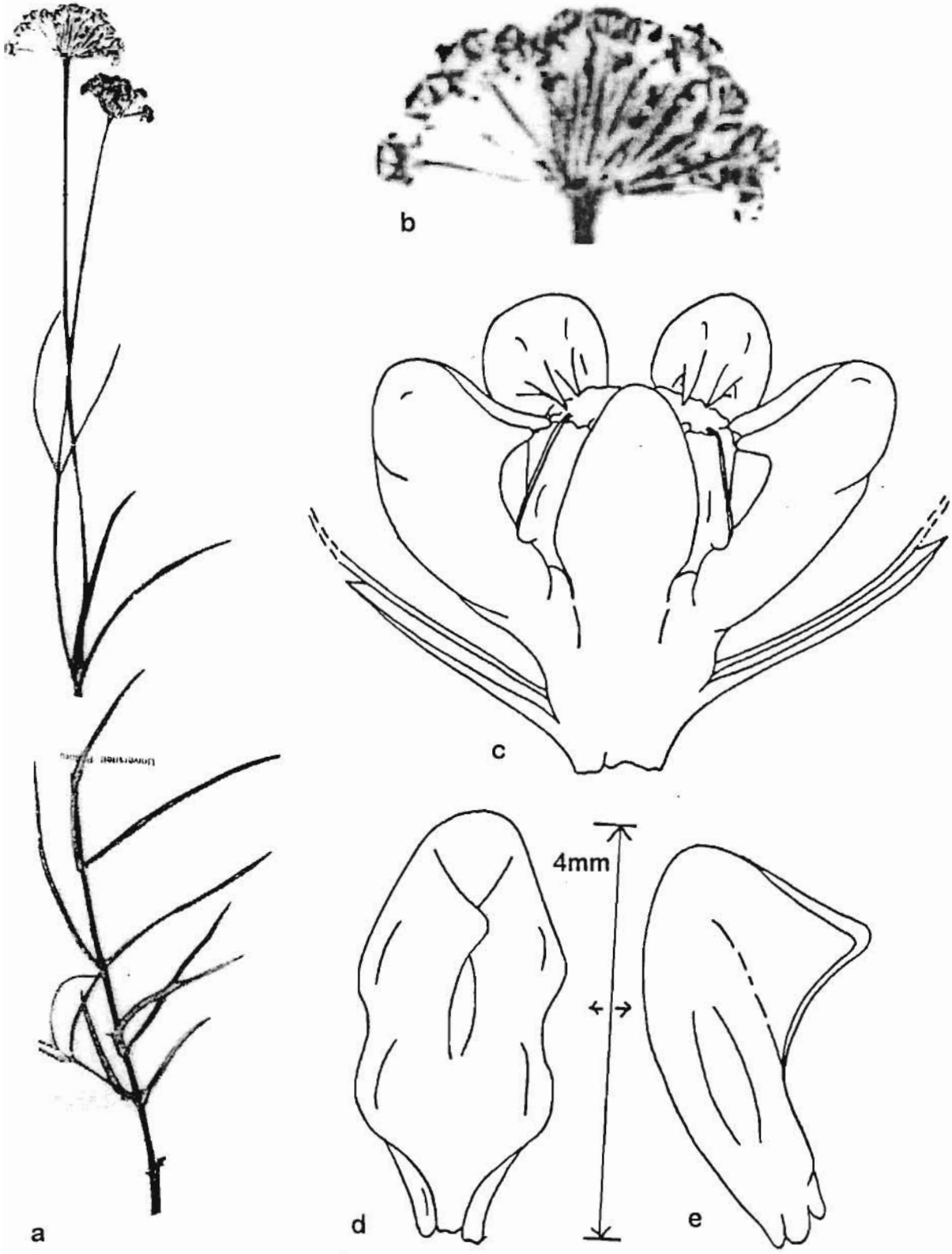


Figure 56. *Pachyacris sp. nov. c*: a. Part of whole plant showing habit; b. Enlargment of inflorescence c. Close up of flower (showing gynostegial-column) with calyx & corolla removed; d. Front view of corona-lobe; e. Side view of corona-lobe. Drawings by A. Nicholas.

[GRA]; *Bakelmann 8 Plate 41*, Hogsback [NBG]; *Acocks 12273*, near Indutywa [PRE]. **Without Precise Locality**: *Scully s.n.* [SAM possibly isosyntype].

28. *Pachyacris woodii* (Schltr.) Nicholas & Goyder. *Comb. nov.* **Type:** *Wood 4258,* South Africa, KwaZulu-Natal, near Howick [Lecto. NH with drawing] (fig. 52). Chosen here. *Gerrard & McKen s.n.*, South Africa, KwaZulu-Natal, without precise locality [Iso. B†].

Gomphocarpus woodii Schltr., in Journ. Bot. 32: 258 [1894]. **Type:** As above.

Asclepias woodii (Schltr.) Schltr., in Journ. Bot. 34: 456 [1896]. **Type:** As above.

Discussion: *P. woodii* (fig. 52) although allied to *P. fallax*, *P. densiflora* and *P. cooperi* is quite unique and distinct; something also pointed out by Schlechter 1894. Stems are always solitary, completely erect (never decumbent at the base and then erect) and up to 650mm tall. Despite the long stems there are usually only 4 pairs of long (56 to 134mm) leaves (rarely pairs 3, 5 or 6). The inflorescences are almost always produced in a terminal pair. Brown (1908) also mentions the crystals that can be seen in the membranous anther-appendages. The erect stems and long penuncles possessed by *P. woodii* and its allies seem to be an adaption to hold the flowers above the grass level making them more visible to pollinators. Unlike the other species of *Pachyacris* these species seem to grow primarily in unburned grasslands, making floral visibility a problem. *P. woodii* occurs at altitudes of between 600 and 1400 meters. Flowers have a pale green corolla and corona that is yellow apically and on the keel but dark purple below. These are produced between November and January. Fox & Norwood Young (1982) say the Zulu call this *ishangangube*, however, they also say the plant occurs in Swaziland (probably following Compton 1976), but this is not so the plant is a KwaZulu-Natal midland grassveld endemic and the specimens in Swaziland are probably *P. densiflora*. The specimen label on *Mogg 6155* says that the Zulu call this plant *Infulazane* and that it is known to cause *stijfziekte* (a type of poisoning) in domestic animals that have eaten it (fig. 54).

Distribution: South African endemic [KwaZulu-Natal province only] (fig. 55).

Conservation Status: Endangered following Scott-Shaw (1999). This is a rarely collected plant is known from only a few localities in the Natal midlands mainly centered around the town of Howick. This area of the Natal midlands is very heavily affected by farming, afforestation and increasing urbanization. This plant must be considered endangered and its medium to long term survival is doubtful.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1020*, near Pietermaritzburg [NU]; *Nicholas 1027*, Howick [CPF, NU]; *Wylie 22358*, Greytown district [NH]; *Wylie s.n.*, Town Lands farm, Muden [NH 27984]; *Schrire 711*, 21kms from Merrivale on Boston road [NH]; *Pegler ex Wood 11038*, Tweedie [NH, SAM]; *Kunhardt 45*, Kunhardt's farm [NH]; *Mogg 6155*, Melmoth [PRE]; *Mogg s.n.*, Dargle road [PRE 51759].

ASPIDONEPSIS Nicholas & Goyder, in Bothalia 22(1): 25 [1992]. **Type Species:** *Aspidonepsis diploglossa* (Turcz.) Nicholas & Goyder.

Discussion: Although this genus has been dealt with in some detail in Nicholas & Goyder (1992) we have included it here for completeness and because more data on this genus has come to light since then. Distributions have been expanded, more types located (such as the discovery of an isotype of *P. shebae* at the Moss herbarium), and the inclusion of *Aspidoglossum delagoense* into this genus. For generic and specific description and detailed discussion of each taxon see Nicholas & Goyder (1992). Under representative specimens we have, as far as possible, tried to cite more recent collections or collections not cited in other published works.

Key to Species:

1a Corolla reflexed when mature. Corona-lobe sinus without an appendage (Subgenus *Unguilobium*) 6

1b Corolla not fully reflexed when mature. Corona-lobe sinus with a tongue-like appendage (Subgenus *Aspidonepsis*) 2

2a Upper proximal corona-lobe appendages projecting over the

style-apex 3

2b Upper proximal corona-lobe appendages not projecting over the style-apex 4

3a Peduncles 3—92mm long. Petals 2.5—5.8mm wide. Corona-lobe sinus appendage broadly tongue-like. Distribution uplands ..... *A. cognata*

3b Inflorescences sessile. Petals 1.5—2.0mm wide. Corona-lobe sinus appendage long & spike-like. Distribution coastal & highlands ..... *A. delagoense*

4a Corona-lobes with arm-like upper proximal appendages that cross over each other & then reflex back into the coronal cavity; sinus appendage botuliform or sausage-shaped ..... *A. flava*

4b Corona-lobes without true proximal appendages or these present & dentate but never crossed over each other; sinus appendage broadly ligulate or spike-like 5

5a Flowers yellow. Petals 2.5—4.0mm wide. Corona-lobes cup-like; sinus appendage broadly tongue-shape. Distribution uplands & midlands ..... *A. diploglossa*

5b Flowers yellowish brown, brown or rarely white. Petals 1.5—2.0mm wide. Corona-lobes boat-shaped; sinus appendage long & spike-like. Distribution coastal & highveld ..... *A. delagoense*

6a Corona-lobe keel deeply cleft ..... *A. reenensis*

6b Corona-lobe keel entire (not cleft) ..... *A. shebae*

ASPIDONEPSIS Subgenus *ASPIDONEPSIS*

1. *Aspidonepsis delagoense* (Schltr.) Nicholas & Goyder. *Comb nov.* **Type:** *Junod 184,* Mozambique, Delagoa Bay [Holo. B† *n.v.*]. *Junod 484,* Mozambique, Delagoa Bay [Holo. B† *n.v.*].

Schizoglossum delagoense Schltr., Bull Herb Boiss. 4: 446 [1896]. **Type:** As above

Aspidoglossum delagoense (Schltr.) Kupicha, Kew Bull., 38(4): 663 [1984] **Type:** As above.

Discussion: This species was included by Kupicha (1984) in the genus *Aspidoglossum* based primarily on pollinarium shape and to a degree its sessile inflorescences. However, as already pointed out (Nicholas & Goyder, 1992) *A. delagoense* is in many ways intermediate between *Aspidoglossum* and *Aspidonepsis*. Recently studies initiated on *Aspidoglossum* and allies indicate that *A. delagoense* is, in fact, better placed in *Aspidonepsis* where most of its floral features (in particular the corona and pollinarium) place it. The pollinarium fit as well with those of *Aspidonepsis* as it does with those of *Aspidoglossum* and sessile inflorescences can also be found in *A. diploglossa* making this character not unique to *Apsidoglossum*. With its corona-lobe sinus appendage it fits well in subgenus *Aspidonepsis*. *A. delagoense* differs from the other species in this subgenus by the following characters: Its oblong-ovate petals only 1.5 to 2.0mm wide and with subactute apices, shallowly boat-shaped (almost laminar) corona-lobes, short dentate erect upper proximal corona-lobe appendages that reach only half-way up the staminal-column, shallow corona-lobe sinus with a long spike-like backwardly directed appendage, broadly ovate anther-appendages and narrowly oblong (rather than ±tear drop-shaped) pollinia. Unlike the other species they probably occur in long rather than short grasslands and are coastal and highveld rather than midland and upland in distribution. Plants are found growing in tall grasslands on sandy soils and flowering in September. In KwaZulu-Natal in coastal Maputoland only. Illustrated in Nicholas & Goyder 1992 (flower and pollinarium only).

Distribution: African endemic. South Africa [KwaZulu-Natal province in coastal Maputoland only], Swaziland and Mozambique (fig. 58).

Conservation Status: Low Risk (Near Threatened) following Scott-Shaw (1999) .

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 2143 with MacDevette*, Eastern Shore State Forest [PRE]; *Vahrmejier 1209*, Inguavuma district [PRE]; *Germishuizen 3585*, Muzi Swamp between Phelendaba & Mbazwana [PRE]; *Moll 4727*, Manzengwenya [PRE]; *Stephen, van Graan & Schwabe 1191*, Vasi Swamp [PRE]; *Moll & Strey 3798*, Kosi Bay [PRE]; *Ward 2833*, near Charters Creek [PRE].

2. *Aspidonepsis flava* (N.E. Br.) Nicholas & Goyder, in Bothalia 22(1): 27 [1992]. **Type:** *Tyson 1086*, South Africa, Eastern Cape province, Malowe Mountain [Lecto. K. Iso. BOL, PRE].

Asclepias flava N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 687 [1908] *non* Lilo in Kuntze, Revisio Gen. Plant. 2: 418 [1898]. **Type:** As above.

Discussion: Figure 56. Also, illustrated in Nicholas & Goyder (1992).

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape provinces] (fig. 58).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Eastern Cape populations are particularly vulnerable.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1019*, Blinkwater Mountains, Karkloof [NU]; *Nicholas 1040*, Killikeen farm, Dargle [NU]; *Nicholas 1159 with Norris*, Nkonzo State Forest [CPF]; *Nicholas 2584*, Weza State Forest [CPF]; *Nicholas & Norris 1159*, Nkonzo State Forest [CPF, NH, PRE]; *Nicholas 2080*, Weza State Forest [K, NU]; *Thode 2584*, Sweet Thorne, Krantzkloof [STE]; *Hilliard & Burtt 13491*, Karkloof range [NU]. Eastern Cape: *Dold 2924 with Cloete & White*, Ntabankulu mountain, Gome Forest Station [GRA]; *Brusse 4975*, Kakas Hill, Nungi Mountain near Cedarville [PRE].

3. *Aspidonepsis cognata* (N.E. Br.) Nicholas & Goyder, in Bothalia 22(1): 30 [1992]. **Type:** *Schlechter 6496*, South Africa, Eastern Cape province, Mount Insizwa [Holo K. Iso. BOL, NH, PRE].

Figure 57. *Aspidonepsis flava*: a. Whole plant showing habit (400mm tall); b. Close up of flowering stalk; c. Close up of flowers; d. Flower with visiting beetle. *A. cognata*: e & f. Close up of flowers showing color variation. G. Natal Drakensberg home to *Aspidonepsis flava*, *A. cognata*, *A. diploglossa* and *A. reenensis*. Photographs: a, c, d & g by A. Nicholas; b, e & f by L. Greene.

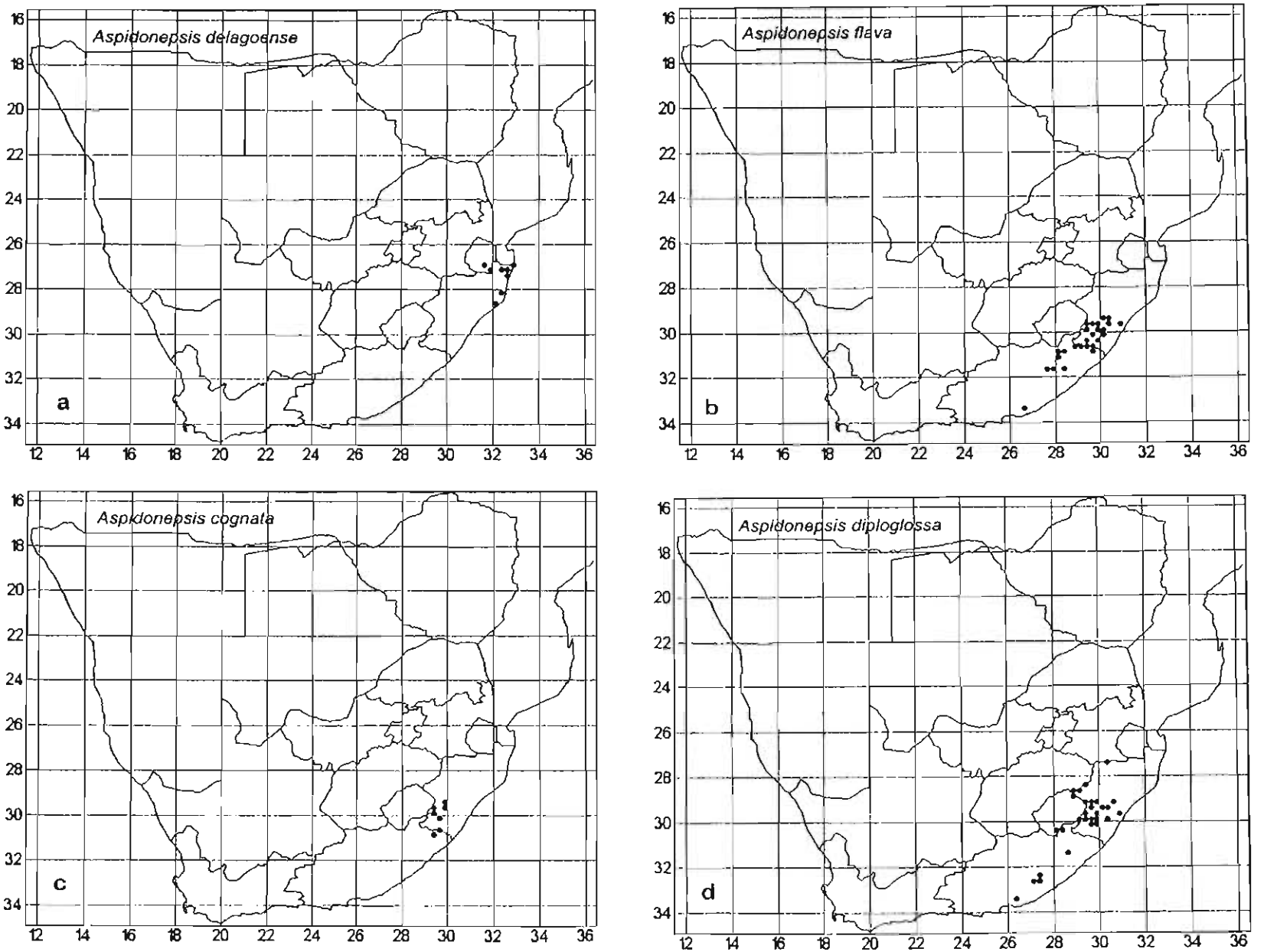


Figure 58. Distribution maps of: a. *Aspidonepsis delagoense*; b. *A. flava*; c. *A. cognata* and; d. *A. diploglossa*.

Asclepias cognata N.E. Br., in Thiselton-Dyer Fl. Cap. 4(1): 687 [1908]. **Type:** As above.

Discussion: Figure 57. Also, illustrated in Nicholas & Goyder (1992).

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape provinces] (fig. 58).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999).

Representative Specimens: South Africa: KwaZulu-Natal: *Stewart & Manning 2230*, Garden Castle Nature Reserve [NU]; *Hilliard & Burtt 15577*, Bamboo Mountain above Restmount [NU, PRE]; *Hilliard & Burtt 17090*, Gxalingenwa valley [NU]; *Hilliard & Burtt 13452*, Garden Castle Forest Reserve [NU]; *Hilliard & Burtt 14871*, Mlombonja valley [NU]. Eastern Cape: *Nicholas 2081*, Weza State Forest [NH, MO].

4. *Aspidonepsis diploglossa* (Turcz.) Nicholas & Goyder, in Bothalia 22(1): 26 [1992]. **Type:** *Ecklon 23,* South Africa, Eastern Cape province, peaks of the Winterberg [Holo KW. Iso. PRE].

Gomphocarpus diploglossus Turcz., in Bull. Nat. Moscou, 1: 250—262 [1848]. **Type:** As above.

Asclepias diploglossus (Turcz.) Druce, in Rep. Bot. Exch. Cl. Br. Isles, 1916: 605 [1917]. **Type:** As above.

Asclepias schizoglossides Schltr., in Engl. Bot. Jahrb. 18(5). Beibl. 45: 32 [1894]. **Type:** *Barber s.n.,* South Africa, Eastern Cape province, mountain side [Neo. K].

Discussion: Fig. 59. Also, illustrated in Nicholas & Goyder (1992).

Distribution: Southern African endemic. Lesotho and South Africa [Free State, KwaZulu-Natal & Eastern Cape provinces] (fig. 58).

Conservation Status: Low Risk (Least Concern). Eastern Cape populations are particularly vulnerable.

Representative Specimens: Lesotho: *Killick 4327*, Sehlabathebe National Park [PRE]. **South Africa:** Free State: *Blom 287*, Seheletwane, Metz farm [PRE]; *Jacobsz 3511*, Klawervlei, Harrismith [PRE]. KwaZulu-Natal: *Nicholas 966*, Giant's Castle Game Reserve [NU]; *Nicholas 2745 with Poorun*, Sani Pass [UDW]; *MacDevette 5410*,

Troutbeck Valley, Cobham State Forest [PRE]; *Thode 5410*, Olivershoek Pass [JF, STE]; *Thode 5410*, Olivier's Hoek Pass [PRE]; *Balkwill, Manning & Meyer 1072*, Cathkin Peak [NU]; *Hilliard & Burtt 15557*, Bamboo Mountain above Restmount [NU, PRE]; *Hilliard & Burtt 17436*, Tarn Cave, Bushman's Nek [J, NU]; *Hilliard & Burtt 18589*, Bushman's Nek [NU]; *Hilliard & Burtt 13774*, Garden Castle State Forest [NU]; *Hilliard & Burtt 17741*, Chameleon Cave [NU]. Eastern Cape: *A & G Hutchings 1893*, Thaba Chitja, Ongeluk's Nek [PRE]; *A & G Hutchings 1963*, Mjika, slopes above Mhlahlane Forest Reserve.

ASPIDONEPSIS* Subgenus *UNGUILOBIUM Nicholas & Goyder, in Bothalia. 23(2): 236 [1993]. **Type species:** *Aspidonepsis reenensis* (N.E. Br.) Nicholas & Goyder.

5. *Aspidonepsis reenensis* (N.E. Br.) Nicholas & Goyder, in Bothalia. 23(2): 237 [1993]. **Type:** *Wood 8635*, South Africa, KwaZulu-Natal province, Van Reenen [Holo K. Iso. GRA, NH, PRE, SAM].

Asclepias reenensis N.E. Br.,Thiselton-Dyer Fl. Cap. 4(1): 1131 [1992]. **Type:** As above.

Discussion: Figure 59. Also, illustrated in Nicholas & Goyder (1992).

Distribution: Southern African endemic. Lesotho, South Africa [Mpmalanga & KwaZulu-Natal provinces] and Swaziland (fig. 59).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Vulnerable in areas not protected by the KwaZulu-Natal Nature Conservation Service.

Representative Specimens: Lesotho: *Boardman 186*, Ramatselisos Gate [PRE]. **South Africa:** Mpumalanga: *Balkwill & Stalmans 7738*, Duurstede farm, Songimvelo Game Reserve [J]. KwaZulu-Natal: *Nicholas 2751 with Poorun & Govender*, Giant's Castle Game Reserve [UDW]; *Nicholas 2760 with Poorun & Govender*, Kamberg [PRE]; *Balkwill, Manning & Meyer 1108*, Monks Cowl Forest Reserve [NU]; *Killick 1205*, Cathedral Peak State Forest [PRE]; *Trauseld 1042*, Giant's Castle Game Reserve [PRE]; *Bos 999*, Highmoor State Forest/Giant's Castle [PRE]; *Hilliard & Burtt 18627*, Mulangane, above Carters Nek [NU]. Swaziland: *Karsten s.n.*, Bomva Ridge [PRE].

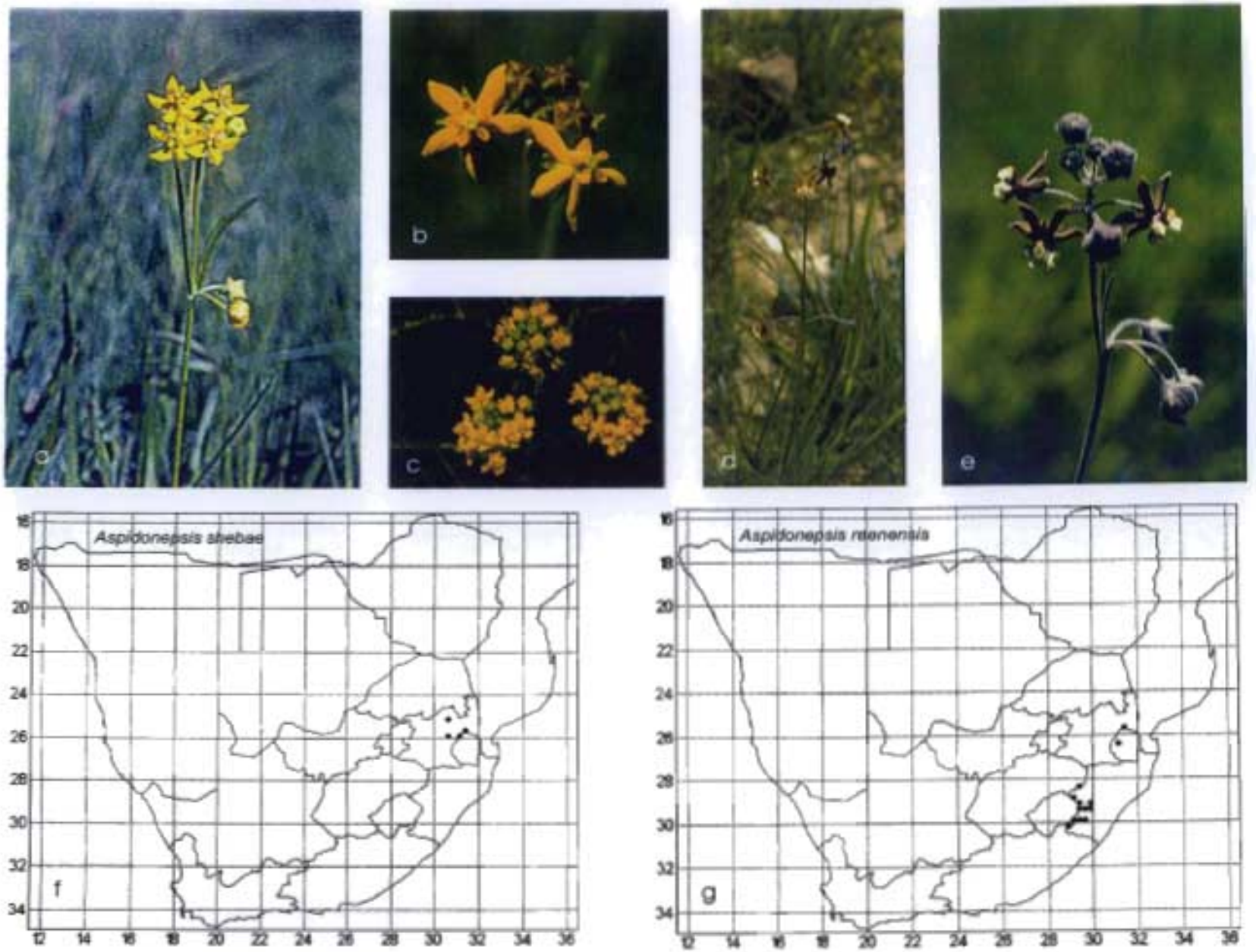


Figure 59. *Aspidonepsis diploglossa*: a. & c. Inflorescences; b. Close up of flowers. *A. reenensis*: d. Stem showing habit (500mm tall); e. Close up of flowers; g. Distribution. *A. shebae*: Distribution.

6. ***Aspidonepsis shebae*** Nicholas & Goyder, in Bothalia 22(1): 33 [1992]. **Type:** *Forrester & Gooyer 216*, South Africa, Mpumalanga province, Mt Sheba Nature Reserve [Holo. PRE. Iso. J].

Discussion: Illustrated in Nicholas & Goyder (1992).

Distribution: South African endemic [Mpumalanga province only] (fig. 59).

Conservation Status: Endangered.

Representative Specimens: South Africa: Mpumalanga: *Smuts & Gillett 2370*, Mount Anderson [PRE]; *Smuts & Gillett 2326*, Mauchsberg [PRE]; *Forrester & Gooyer s.n.*, Mount Sheba Nature Reserve [NH 85477]; *Germishuizen 5679*, Songimvelo Game Reserve [PRE]; *Meyer 9*, Kangwane, Songimvelo Game Reserve.

ASCLEPIAS L. Sp. Pl. edn. 1: 214 [1753]. **Type Species:** *Asclepias speciosa* L. (Fig. 59).

Asclepias L. section *Euasclepias* K. Schum., in Engl. & Prantl, Pflzfam. 4(2): 238 [1895].

Crassa Rupp., Fl. Jen. edn 3: 26 [1745]. **Type species:** Not designated.

Dassovia Neck., Elem. I: 257 [1790]. **Type species:** Not designated.

Anthanotis Raf., Fl. Ludov.: 52 & 149 [1817]. **Type:** *A. procumbens* Rafin. Selected here.

Acerates Elliott, Sketch Bot. S. Carolina 1: 316 [1817]. **Type species:** *A. longifolia* (Michx) Elliott (= *Asclepias longifolia* Michx.).

Podostigma Ellott, Sketch Bot. S. Carolina, 1: 326 [1817]. **Type species:** Not designated.

Stylandra Nutt., Gen. N. Amer. Pl. 1: 170 [1818]. **Type species:** *S. pumila* Nutt (= *Asclepias pedicellata* Walter)* . *Nom. illeg.* = *Podostigma* Elliott.

Anantherix Nutt., Gen. N. Amer. Pl. 1: 169 [1818]. **Type species:** *A. viridis* (Walter) Nutt. (= *Asclepias viridis* Walter).

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* *vide* ***Index Nominum Genericorum (Plantarum)***: http://www.nmnh.si.edu/cgi-bin/wdb/ing

Acerotis Raf., New Fl. Amer. 1: 49 [1836], in error for *Acerates* Elliott.

Oligoron Raf., New Fl. Amer. 4: 60. 1838 [1836]. *Nom. superf.* = *Acerates* Elliott

Otanema Raf., New Fl. Amer. 4: 61 1838 [1836]. **Type species:** Not designated.

Onistis Raf., New Fl. Amer. 4: 63. 1838 [1836]. **Type species:** *O. longifolia* Raf. (= Convolvulaceae?)

Polyotus Nutt., in Trans. Amer. Phil. Soc. Ser. 2 (5): 199 [1837] *non* Gottsche, in Gottsche et al., Syn. Hepat. 244: 14—16 [1845]. **Type species:** Not designated.

Otaria Kunth ex G.Don, Gen. Hist. 4: 144 [1837] ed fol.: 150. 1819 [1818]. **Type species:** *O. auriculata* (Kunth) G. Don.

Asclepiodora A. Gray, in Proc. Amer. Acad. Arts 12: 66 [1876]. **Type species:** Not designated.

Oxypteryx Greene, in Pittonia 3: 234 [1897]. **Type species:** *O. arenicola* (Nash) Greene (= *Asclepias arenicola* Nash).

Asclepiodella J.K.Small, Man. S.E. Fl.: 1073 [1933]. **Type species:** *A. feayi* (Chapm. ex A. Gray) J.K. Small (= *Asclepiodora feayi* Chapm. ex A. Gray)

Biventraria J.K. Small, Man. S.E. Fl.: 1072 [1933]. **Type species:** *B. variegata* (L.) Small (= *Asclepias variegata* L.)

Asclepias L. section *Podostemma* A. Gray, in Proc. Amer. Acad. 12: 72 [1876]. **Type species:** *P. longicornu* (Benth.) Greene (= *Asclepias longicornu* Benth.)

Podostemma (A. Gray) Greene, in Pittonia 3: 235 [1897]. **Type species:** *P. longicornu* (Benth.) Greene (= *Asclepias longicornu* Benth.)

A number of these have been recognized at subgeneric rank by Woodson (1954). *Solanoa* Greene, *Schizonotus* A. Gray *non* Lindl. and *Solanoana* Kuntze are also sometimes included under the synonomy.

Description: *Habit*: Usually perennial, occasionally annual or biannual, small herbs to small shrubs; usually with milky latex. *Underground-organ:* fibrous or a swollen woody stem-tuber. *Stems* usually many, rarely solitary, unbranched or branched then usually from the base, 40—2000mm long, decumbent to erect, very slender to stout, glabrous or hairy. *Leaves* usually opposite & decussate, rarely 4 to a node or irregularly alternate, spreading to spreading erect, simple, entire, sessile or petiolate; blades filiform, linear, lanceolate, ovate to elliptic, herbaceous, apex acute to obtuse, rarely emarginate or

mucronate, base cuneate, round, truncate, cordate to hastate, margins flat or revolute, all level of venation prominent or midrib only; petioles prominent, very short or appearing sessile, sometimes with small colleteres in the axils. *Inflorescences* usually umbel-like, rarely solitary or cymose, terminal or terminal & lateral at the nodes, usually erect, rarely pendulous; peduncles long; with or without bracts. *Flowers* rotate, yellow, red, orange, pink, lilac, green, brown or whitish; pedicel long. *Calyx* 5-merous, usually with minute squamellae at the base inside; lobes ovate to lanceolate, apex acute, glabrous to pubescent. *Corolla* 5-merous, more or less divided to base, if fused at base then tube very short, reflexed, spreading to spreading erect; lobes ovate, oblong to elliptic, apex acute, subacute to obtuse, margin flat or slightly revolute. *Staminal-corona* in 2-series or appearing pseudomonoseriate. Outer corona produced at or above the gynostegial-column base, 5-merous, shorter than to much over topping the style-apex; lobes fused to staminal-curtain below, free above, erect, fleshy, simple to complicate cucullate, usually cup- or tube-like, with a central cavity or sinus this usually with an inner appendage that is teretee & horn-like, laterally compressed & tongue-like, rounded, ridge-like or rarely absent. Inner corona alternating with outer, lobule-like, small, erect and usually bifid, rarely entire or rudimentary. *Staminal-column*: cylindrical, stout or long & narrow with the style-stigma-head swollen & knob-like apically; anther–appendages present. *Pollinaria*: Pollinia solitary, pendulous in each anther-sac, small or large, usually obclavate to lacrimiform; translator–arms long & thin to thick & short, attached appically to pollinia; corpusculum ellipsoidal. *Style-apex* truncated & sunk in the middle. *Follicle*: Usually solitary & erect, rarely paired & spreading erect, usually narrowly fusiform, rarely fusiform-ovoid to broadly ovoid, apex usually beaked & acute, usually smooth, warty or with echinate bristles, glabrous to pubescent; pedicel in fruit straight or S-bent. *Seeds*: dorso-ventrally flattened, adaxial surface shallowly convex, abaxial surface shallowly concave, ovate, surface usually smooth. *Etymology*: Named after the Greek medicine man *Aesculapius* who eventually became immortalized in mythology as the god of medicine. The original plant to bear the name was probably a member of Apocynaceae *sensu stricto*.

Discussion: About 122 species (±110 in North and Central America the rest in South America). Plants terrestrial or semiaquatic (sometimes in brackish water) (Rosatti, 1989).

Some species are weedy in disturbed areas, but they are found in a wide range of habitats from desterts to prairies to woodland to swamps (Heron, 1981). Woodson (1954) recognized nine subgenera. Bollwinkel (1969) revised the genus for South America. The *Asclepias* species in the United States are possibly the most well researched in the family with an abundance of literature dealing with aspects of reproductive and pollination biology, anatomy, chemistry, plant-animal interactions and population studies. It is also one of the few countries in which plants are grown commercially for their latex which contains 30% hydrocarbons and an excellent source of high grade oil (Heron, 1981).

Distribution: New World endemic, found elsewhere only as an introduced plant.

1. ***Asclepias curassavica*** L. Sp. Pl. 1: 215 [1753]. **Type:** *Without collector or number*, in Liin. herb [Lecto. LINN 310.18] (fig. 60). Selected here.

Asclepias nivea L. var. *curassavica* (L.) Kuntze 2: 418 [1891]. **Type:** As above.

Asclepias margaritacea Hoffmannsegg, in Roem. & Schult. Syst. 6: 86 **Type:** [*n.v.*]

Discussion: This species (figs. 60, 61 & 62) is fairly widely used as a garden plant in South Africa, especially in the bigger cities, from where it has subsequently escaped and started to become a nusance weed. In this region it can be identified by its very red to red-orange flowers, large exposed corona-lobe with a long central horn that curves up and over the style-apex and by its long, erect, smooth, green fusiform follicles which are usually produced in unequal pairs (fig. 60). There are two specimens in the Linnean Herbarium (LINN 310.18 and 310.19) (fig. 60), we have chosen the former as the type as it is the better of the two. Common names include blood-flower, butterfly weed, redhead, False ipecac and cotton bush. The specific epithet is apparently derived from Curaçao in South America, from where the specimen in the Linnean herbarium may have come. Plants of this species were cultivated in England in the Royal garden at Hampton court as early as 1692 (Aiton, 1811) and even earlier, 1665, in France (Wijnands, 1983). Cultivated plants are, however, susceptable to the *Asclepias rhabdovirus**. The following

* Plant Viruses Online: http://biology.anu.edu.au/research-groups/MES/vide/famly014.htm. No indication of when last updated. Consulted 20.02.1998.

toxins have been extracted from this species: asclepins, quercetin, kaempferol, condurangin, vincetoxin glycosides, calotroposide and cardenolide glycosides (Hutchings, 1996 and Fumiko et al., 1992). Asclepin have a digitoxin-like cardiotonic action and total extracts from the plant are used as diuretics, expectorants and emetics. Calotroposide shows an inhibiting action on malignant tumors. (Hutchings, 1996). Plants have been suspected in both livestock and human poisoning. Cardenolides from this species feed to orb-web spiders (*Zygiella x-notata* (Clerck)) via aphids (*Aphis nerii* B. de F.) which had sequestered them, made them build severly deformed webs and lowered their effectiveness to trap. Spiders also became aphid weary (Malcom, 1989). This species has been used to test the effects of ozone air pollution (Bolsinger et al., 1992). Illustrated in White (1962) and Haselwood & Motter (1991).

Distribution: For Southern african distribution see figure 59. A native of central America and West Indies? Now found naturalized in the following areas South America?, Florida?, Spain, Cyprus, Morocco, Middle East, West Africa, East Africa, Central Africa, South Africa, Pakistan, Sri Lanka, China, Hawaii, Australia, New Caledonia and Macaronesia

Representative Specimens: South Africa: Gauteng: *Poynton 17086*, Lynnwood, Pretoria [PRE]; *Obermeyer 1108*, Tshakama, Zoutpansberg [PRE]; *Phillips 699*, Pretoria [PRE]; *Burton s.n.*, Johannesburg [PRE 90016284]; *Zorio 10*, Johannesburg [J]; *McMurty 1471*, Johannesburg Botanic Gardens [PRE]. KwaZulu-Natal: *Nicholas 2738 with DC Nicholas*, Amanzimtoti [UDW]. Eastern Cape: *Paterson 1016*, Beaufort West [GRA]. Western Cape: *Dowler s.n.*, Fishhoek [PRE 90016286]; *Piercer 49*, Kirstenbosch [BOL].

Excluded Southern African Species

1. ***Asclepias villosa*** Mill. Dict. 8th edn. N° 14 [1768]

Discussion: From its description this may be *Gomphocarpus tomentosus*, although, according to N.E. Brown (1908), the specimen in Miller's herbarium belongs to *Gomphocarpus physocarpus*. This name is a source of confusion and, as such, we so no

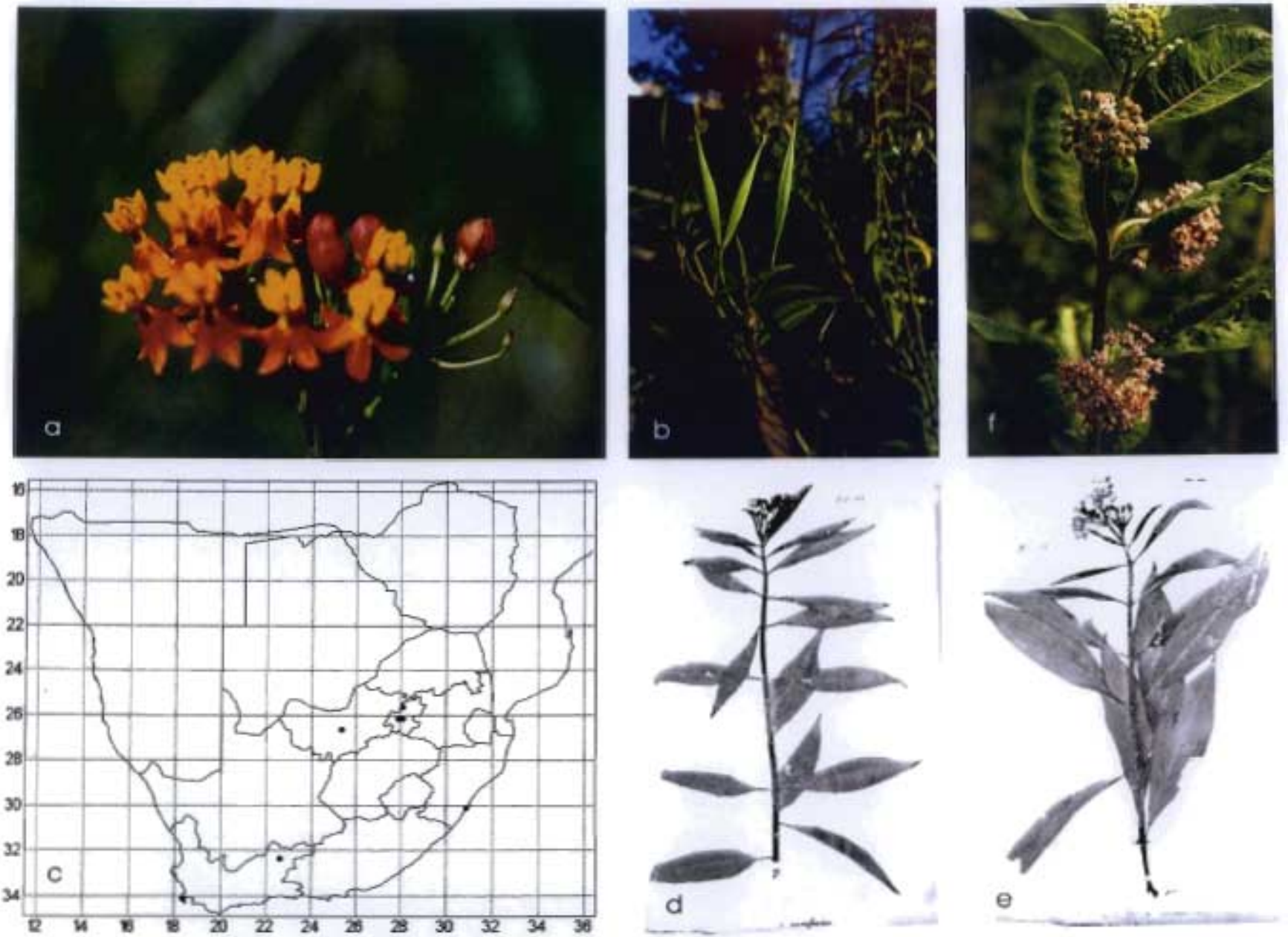

Figure 60. *Asclepias curassavica*: a. Inflorescence; b. Stem with follicles; c. Distribution; d. LINN. 310.19 and e. Lectotype LINN. 310.18 (both housed at Linn. Herb.). *A. syriaca*: Flowering stem. This is the type species of *Asclepias*. Photographs: a, b, d, e & f by A. Nicholas.

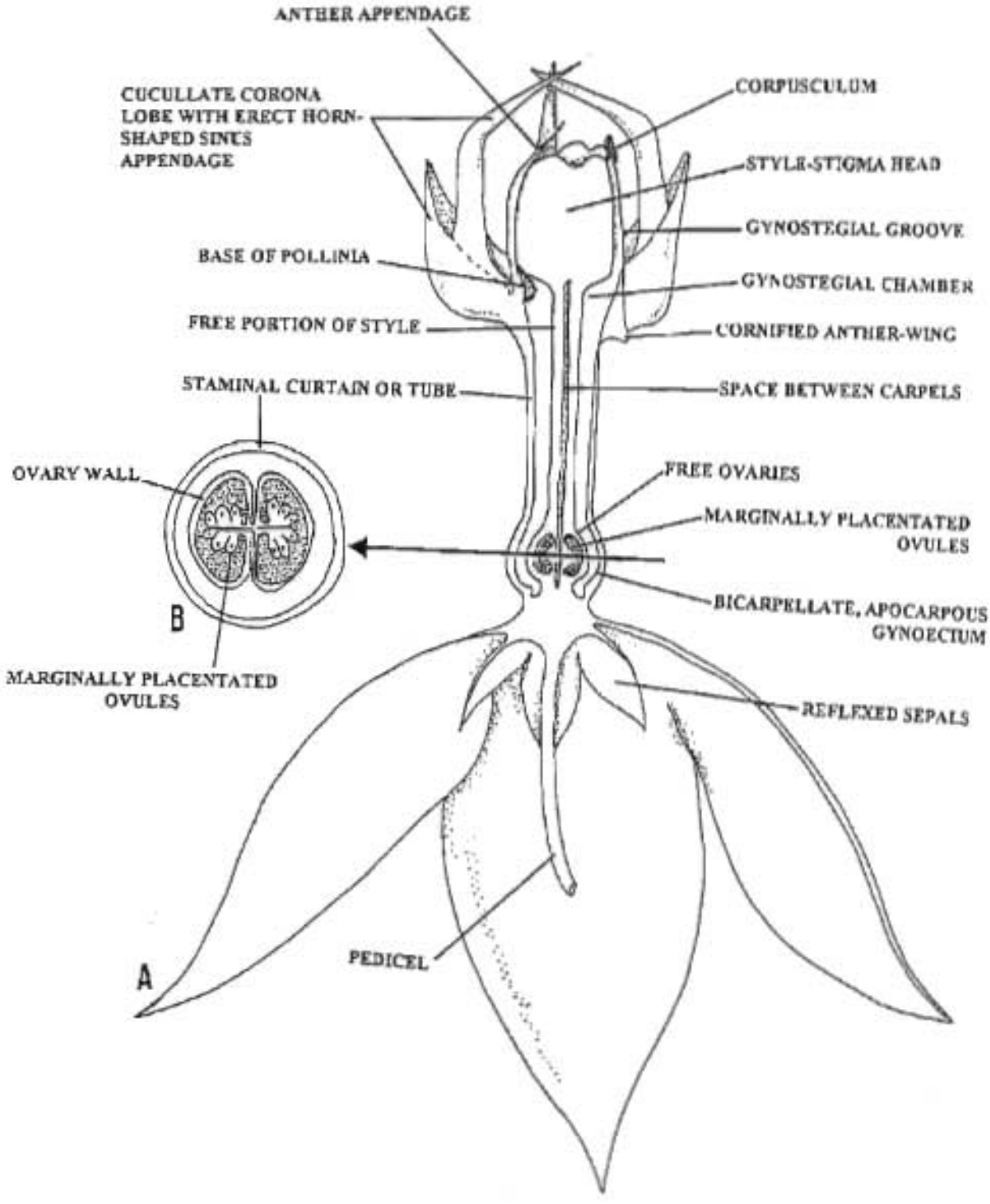

Figure 61. *Asclepias curassavica* flower structure: a. Half flower drawing x14; b. T.S. through carpels x14.

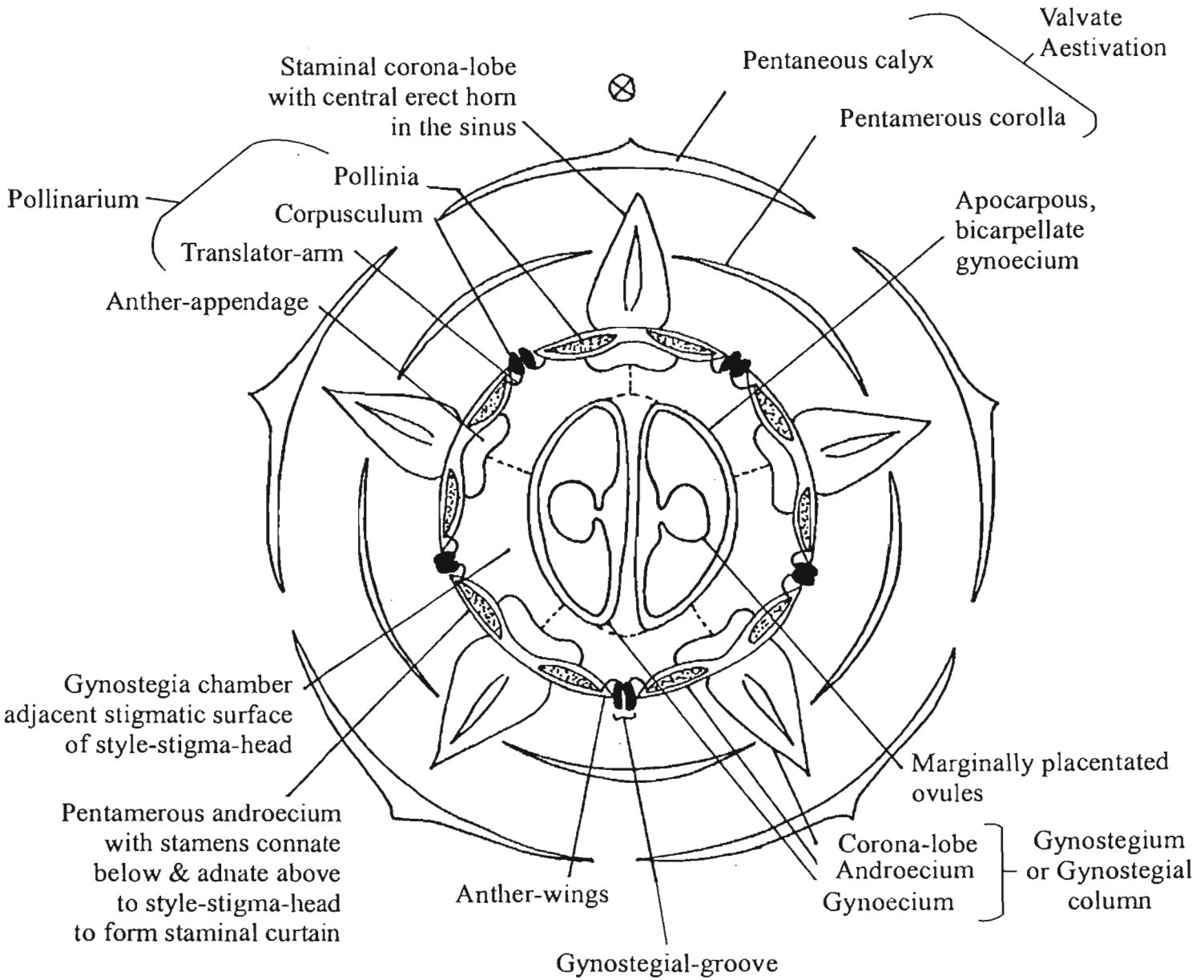

Figure 62. *Asclepias curassavica* flower structure: Labelled floral diagram.

need to neotypify it, and so overturn more well known and widely used names in the genus.

Southern African Names Excluded from the Genus *Asclepias*

A. acerateoides Schltr. = ***Pachyacris acerateoides* (Schltr.) Stewart & Langley ex Nicholas & Goyder**

A. adscendens (Schltr.) Schltr. = ***Pachycaris adscendens* (Schltr.) Nicholas & Goyder**

A. affinis Schltr. = ***Pachycaris albens* (E. Mey.) Nicholas & Goyder**

A. alatus Schltr. = ***Pachycarpus dealbatus* E. Mey.**

A. albens (E. Mey.) Schltr. = ***Pachycaris albens* (E. Mey.) Nicholas & Goyder**

A. anisophylla Conrath & Schltr. = ***Woodia browniana* (S. Moore) Nicholas**

A. aphylla Thunb. = ***Cynanchum gerrardii*?**

A. appendiculata (E. Mey.) Schltr. = ***Pachycarpus appendiculatus* E. Mey.**

A. arborea Salisb. = ***Gomphocarpus cancellatus* (Burm.f.) Bruyns**

A. arborescens L. = ***Gomphocarpus cancellatus* (Burm.f.) Bruyns**

A. aurea (Schltr.) Schltr. = ***Aidomene aurea* (Schltr.) Nicholas & Goyder**

A. aurea (Schltr.) Schltr. var. *vittata* N.E. Br. = ***Aidomene aurea* (Schltr.) Nicholas & Goyder**

A. bicuspis N.E. Br. = ***Sigridia bicuspis* (N.E. Br.) Nicholas**

A. brevicuspis (E. Mey.) Schltr. = ***Bruynsia brevicuspis* (E. Mey.) Nicholas**

A. brevipes (Schltr.) Schltr. = ***Aidomene brevipes* (Schltr.) Nicholas & Goyder**

A. buchenaviana Schinz. = ***Gomphocarpus filiformis* (E. Mey.) Dietr.**

A. burchellii Schltr. = ***Gomphocarpus tomentosus* Burch.**

A. calceolus S. Moore = ***Sigridia viridiflora* (E. Mey.) Nicholas var. *calceola* (S. Moore) Nicholas**

A. cancellata Burm.f. = ***Gomphocarpus cancellatus* (Burm.f.) Bruyns**

A. chloroglossa Schltr. = ***Stenostelma involucratum* (E. Mey.) Nicholas**

A. ciliata Murray = ***Xysmalobium undulatum* (L.) Ait.f.**

A. cognata N.E. Br. = ***Aspidonepsis cognata* (N.E. Br.) Nicholas & Goyder**

A. compressidens (N.E. Br.) Nicholas = ***Bruynsia compressidens* (E. Mey.) Nicholas**

A. concinna (Schltr.) Schltr. = ***Sigridia concinna* (Schltr.) Nicholas**

A. concolor (E. Mey.) Schltr. = ***Pachycarpus concolor* E. Mey. subsp. *concolor***

A. confusa (Scott Elliot) Schltr. = ***Pachycarpus confusa* (Scott Elliot) Nicholas**

A. conspicua N.E. Br. = ***Pachycarpus schweinfurthii* (N.E. Br.) Bullock**

A. convolvulacea Willd. = ***Pergularia daemia* (Forssk.) Chiov. var. daemia**

A. cooperi N.E. Br. = ***Pachyacris cooperi* (N.E. Br.) Nicholas & Goyder**

A. crassifolia Hort. Paris ex Decne. *nom. nud.*

A. crassinervis N.E. Br. = ***Pachyacris crassinervis* (N.E. Br.) Nicholas & Goyder**

A. crinita (Bertoloni) N.E. Br. = **Gomphocarpus fruticosus (L.) Ait.f.**

A. crispa L. = ***Pachycaris crispa* (L.) Nicholas & Goyder var. *crispa***

A. crispa L. var. *plana* N.E. Br. = ***Pachycaris crispa* (L.) Nicholas & Goyder var. *plana* (N.E. Br.) Nicholas & Goyder**

A. crispa L. var. *pseudocrispa* N.E. Br. = ***Pachycaris crispa* (L.) Nicholas & Goyder var. *pseudocrispa* (N.E. Br.) Nicholas & Goyder**

A. cucullata (Schltr.) Schltr. = ***Aidomene cucullata* (Schltr.) Nicholas & Goyder**

A. cultriformis Harv. ex Schltr. = ***Sigridia cultriformis* (Harv. ex Schltr.) Nicholas**

A. dealbata (E. Mey.) Schltr. = ***Pachycarpus dealbatus* E. Mey.**

A. decipiens N.E. Br. = ***Gomphocarpus fruticosus* (L.) Ait.f. var. *decipiens* (N.E. Br.) Nicholas & Goyder**

A. densiflora N.E. Br. = ***Pachyacris densiflora* (N.E. Br.) Nicholas & Goyder**

A. denticulata Schltr. = ***Gomphocarpus physocarpus* E. Mey.**

A. depressa (Schltr.) Schltr. = ***Pachycaris multicaulis* (E. Mey.) Nicholas & Goyder**

A. diploglossa (Turcz.) Druce = ***Aspidonepsis diploglossa* (Turcz.) Nicholas & Goyder**

A. disparilis N.E. Br. = ***Bruynsia disparilis* (E. Mey.) Nicholas**

A. dissona N.E. Br. = ***Bruynsia capitata* (Schltr.) Nicholas**

A. dregeana Schltr. = ***Sigridia viridiflora* (E. Mey.) Nicholas**

A. dregeana Schltr. var. *calceola* (S. Moore) N.E. Br. = ***Sigridia viridiflora* (E. Mey.) Nicholas var. *calceola* (S. Moore) Nicholas**

A. dregeana Schltr. var. *sordida* N.E. Br. = ***Sigridia viridiflora* (E. Mey.) Nicholas var. *calceola* (S. Moore) Nicholas**

A. eminens (Harv.) Schltr. = ***Bruynsia eminens* (Harv.) Nicholas**

A. eustegioides Schltr. = ***Schizoglossum crassipes* S. Moore**

A. expansa (E. Mey.) Schltr. = ***Paulforstera expansa* (E. Mey.) Nicholas**

A. fallax Schltr. = ***Pachyacris fallax* (Schltr.) Nicholas & Goyder**

A. filiformis (E. Mey.) O. Kunze = ***Gomphocarpus filiformis* (E. Mey.) Dietr.**

A. filiformis (E. Mey.) Benth. & Hook.f. *nom. inval.* = ***Gomphocarpus filiformis* (E. Mey.) Dietr.**

A. filiformis (E. Mey.) Benth. & Hook.f. var. *buchenaviana* (Schinz.) N.E. Br. = ***Gomphocarpus filiformis* (E. Mey.) Dietr.**

A. flagellaris Bolus ex Schltr. = ***Gomphocarpus filiformis* (E. Mey.) Dietr.**

A. flanaganii Schltr. = ***Pachyacris hastata* (E. Mey.) Nicholas & Goyder**

A. flava N.E. Br. = ***Aspidonepsis flava* (N.E. Br.) Nicholas & Goyder**

A. flexuosa (E. Mey.) Schltr. = ***Pachycaris flexuosa* (E. Mey.) Nicholas & Goyder**

A. fornicatum N.E. Br. = ***Stathmostelma fornicatum* (N.E. Br.) Bullock**

A. fragrans (E. Mey.) Schltr. = ***Pachycaris flexuosa* (E. Mey.) Nicholas & Goyder**

A. fruticosa L. = ***Gomphocarpus fruticosus* (L.) Ait.f**

A. fruticosa sensu Miller = ***Gomphocarpus physocarpus* E. Mey.**

A. galpinii (Schltr.) Schltr. = ***Pachycarpus galpinii* (Schltr.) N.E. Br.**

A. geminata Roxb. = ***Gymnema sylvestre* (Retz.) Schultes**

A. geminiflora (Schltr.) Schltr. = ***Pachycarpus concolor* E. Mey. subsp. *concolor***

A. gerrardii (Harv.) Schltr. = ***Trichocodon campanulatus* (Harv.) Nicholas var *gerrardii* (Harv.) Nicholas**

A. gibba (E. Mey.) Schltr. = ***Bruynsia gibba* (E. Mey.) Nicholas**

A. gibba (E. Mey.) Schltr. var. *media* N.E. Br. = ***Bruynsia xmedia* (N.E. Br.) Nicholas**

A. glaberrimus Oliv. = ***Kanahia laniflora* (Forssk.) R. Br.**

A. glabra Miller = ***Gomphocarpus fruticosus* (L.) Ait.f.**

A. glaucophylla (Schltr.) Schltr. = ***Gomphocarpus glaucophyllus* Schltr.**

A. gomphocarpoides (E. Mey.) Schltr. = ***Woodia gomphocarpoides* (E. Mey.) Nicholas**

A. gordon-grayae Nicholas = ***Paulforstera gordon-grayae* (Nicholas) Nicholas**

A. grandiflora L.f. = ***Pachycarpus grandiflorus* (L.f.) E. Mey. var. *grandiflorus***

A. grandiflora L.f. var. *chrysantha* Schltr. = ***Pachycarpus grandiflorus* (L.f.) E. Mey. var. *grandiflorus***

A. harveyana (Schltr.) Schltr. = ***Pachycaris prunelloides*** **(Turcz.) Nicholas & Goyder**

A. hastata (E. Mey.) Schltr. = ***Pachyacris hastata*** **(E. Mey.) Nicholas & Goyder**

A. hastata Thunb. = ***Eustegia minuta*** **(L.f.) N.E. Br.**

A. humilis (E. Mey.) Schltr. = ***Aidomene humilis*** **(E. Mey.) Nicholas & Goyder**

A. insignis (Schltr.) Schltr. = ***Pachycarpus concolor*** **E. Mey. subsp.** ***transvalensis*** **(Schltr.) Nicholas**

A. laniflora Forssk. = ***Kanahia laniflora*** **(Forssk.) R. Br.**

A. linearis (E. Mey.) Schltr. *pro parte non* Scheele= ***Trichocodon linearis*** **(E. Mey.) Nicholas**

A. linearis (E. Mey.) Schltr. *pro parte non* E. Mey. = ***Trichocodon campanulatus*** **(Harv.) Nicholas var** ***campanulatus***

A. linearis (E. Mey.) Schltr. *pro parte non* E. Mey. = ***Trichocodon campanulatus*** **(Harv.) Nicholas var** ***sutherlandii*** **(N.E. Br.) Nicholas**

A. mackenii (Harv.) Schltr. = ***Pachycarpus mackenii*** **(Harv.) N.E. Br.**

A. macra Schltr. = ***Trichocodon suaveolens*** **(Schltr.) Nicholas**

A. macrochila Schltr. = ***Pachycarpus macrochilus*** **(Schltr.) N.E. Br.**

A. macropus (Schltr.) Schltr. = ***Pachycaris macropus*** **(Schltr.) Nicholas & Goyder**

A. meliodora Schltr. = ***Pachyacris meliodora*** **(Schltr.) Nicholas & Goyder**

A. meliodora Schltr. var. *brevicoronata* N.E. Br. ***Pachyacris meliodora*** **(Schltr.) Nicholas & Goyder**

A. meyeriana (Schltr.) Schltr. = ***Aidomene meyeriana*** **(Schltr.) Nicholas & Goyder**

A. monticola N.E. Br. = ***Pachycaris monticola*** **(N.E. Br.) Nicholas & Goyder**

A. mucronata Thunb. = ***Woodia mucronata*** **(Thunb.) N.E. Br.**

A. multicaulis (E. Mey.) Schltr. = ***Pachycaris multicaulis*** **(E. Mey.) Nicholas & Goyder**

A. multiflora (Decne.) N.E. Br. = ***Schizoglossum*** **species.**

A. muricata Schum. & Thonn. = ***Pergularia daemia*** **(Forssk.) Chiov. var.** ***daemia***

A. nana Verdoorn = ***Aidomene nana*** **(Verdoorn) Nicholas & Goyder**

A. navicularis (E. Mey.) Schltr. = ***Bruynsia navicularis*** **(E. Mey.) Nicholas**

A. navicularis (E. Mey.) Schltr. var. *compressidens* N.E. Br. = ***Bruynsia compressidens*** **(E. Mey.) Nicholas**

A. nivea Burm.f. = ***A. nivea*** **L.** Not a southern African species.

A. nuda Schumach. & Thonn. = ***Sarcostemma viminale* (L.) R. Br.**

A. ochroleuca (Schltr.) Schltr. = ***Pachyacris gerrardii* (Scott Elliot) Nicholas & Goyder**

A. orbicularis (E. Mey.) Schltr. = ***Pachycarpus orbicularis* (E. Mey.) Nicholas**

A. oreophila Nicholas = ***Aidomene oreophila* (Nicholas) Nicholas & Goyder**

A. oxytropis (Turcz.) Schltr. = ***Bruynsia gibba* (E. Mey.) Nicholas**

A. pachyglossa (Schltr.) Schltr. = ***Pachycaris parviflora* (Harv. ex Scott Elliot) Nicholas & Goyder**

A. pachystephana (Schltr.) Schltr. = ***Schizoglossum linifolium* Schltr.**

A. patens N.E. Br. = ***Paulforstera patens* (N.E. Br.) Nicholas**

A. peltigera (E. Mey.) Schltr. = ***Paulforstera peltigera* (E. Mey.) Nicholas**

A. physocarpa (E. Mey.) Schltr. = ***Gomphocarpus physocarpus* E. Mey.**

A. praemorsa Schltr. = ***Paulforstera trancata* (E. Mey.) Nicholas**

A. pseudocrispa Schltr. = ***Pachyacris crispa* (L.) Nicholas & Goyder var. *pseudocrispa* (Schltr.) Nicholas & Goyder**

A. pubescens L. = ***Gomphocarpus cancellatus* (Burm.f.) Bruyns**

A. pulchella (Decne.) N.E. Br. = ***Trachycalymma pulchellum* (Decne.) Bullock**

A. rara N.E. Br. = ***Sigridia rara* (N.E. Br.) Nicholas**

A. rectinervis (Schltr.) Schltr. = ***Pachycarpus confusa* (Scott Elliot) Nicholas**

A. reenensis N.E. Br. = ***Aspidonepsis reenensis* (N.E. Br.) Nicholas & Goyder**

A. reflectens (Schltr.) Schltr. = ***Pachycarpus reflectens* E. Mey.**

A. repanda Steud. = ***Pachyacris crispa* (L.) Nicholas & Goyder var. *crispa***

A. rigida (E. Mey.) Schltr. = ***Pachycarpus rigidus* E. Mey.**

A. rivularis (Schltr.) Schltr. = ***Gomphocarpus rivularis* Schltr.**

A. rotundifolia Mill. = ***Gomphocarpus cancellatus* (Burm.f.) Bruyns**

A. rostrata N.E. Br. = ***Gomphocarpus rostrata* (N.E. Br.) Bullock**

A. sabulosa Schltr. = ***Pachycaris crispa* (L.) Nicholas & Goyder var. *pseudocrispa* (N.E. Br.) Nicholas & Goyder**

A. salicifolia Salisb. = ***Gomphocarpus fruticosus* (L.) Ait.f.**

A. scaber (Harv.) Schltr. = ***Pachycarpus scaber* (Harv.) N.E. Br.**

A. scabridiflolia Schltr. = ***Pachyacris acerateoides* (Schltr.) Nicholas & Goyder**

A. scandens Beauv. = ***Pergularia daemia* (Forssk.) Chiov. var. daemia**

A. schinziana (Schltr.) Schltr. = ***Pachycarpus schinzianus*** **(Schltr.) N.E. Br.**

A. schizoglossoides Schltr. = ***Aspidonepsis diploglossa*** **(Turcz.) Nicholas & Goyder**

A. schlechteri K. Schum. = ***Paulforstera schlechteri*** **(K. Schum.) Nicholas**

A. schweinfurthii N.E. Br. = ***Pachycarpus schweinfurthii*** **(N.E. Br.) Bullock**

A. simplex (Schltr.) Schltr. = ***Aidomene revoluta*** **(Schltr.) Nicholas & Goyder**

A. sinuosa Burm. f. = ***Pachyacris crispa*** **(L.) Nicholas & Goyder var. *crispa***

A. stellifera Schltr. = ***Aidomene revoluta*** **(Schltr.) Nicholas & Goyder**

A. stockenstromensis (Scott Elliot) Schltr. = ***Xysmalobium stockenstromense*** **Scott Elliot**

A. suaveolens (Schltr.) Schltr. = ***Trichocodon suaveolens*** **(Schltr.) Nicholas**

A. sulphurea S. Moore = ***Pachycaris sulphurea*** **(S. Moore) Nicholas & Goyder**

A. sulphurea Schltr. = ***Pachyacris gerrardii*** **(Scott Elliot) Nicholas & Goyder**

A. tenuiflora Schltr. *pro parte* = ***Trichocodon linearis*** **(E. Mey.) Nicholas**

A. tenuiflora Schltr. *pro parte* = ***Trichocodon campanulatus*** **(Harv.) Nicholas var *campanulatus***

A. tenuis (E. Mey.) Schltr. = ***Schizoglossum linifolium*** **Schltr.**

A. transvaalensis (Schltr.) Schltr. = ***Pachycarpus concolor*** **E. Mey. subsp. *transvalensis* (Schltr.) Nicholas**

A. trancata Harv. non Dietr. = ***Paulforstera peltigera*** **(E. Mey.) Nicholas**

A. tysoniana Schltr. = ***Pachyacris tysoniana*** **(Schltr.) Nicholas & Goyder**

A. ulophylla Schltr. = ***Pachyacris ulophylla*** **(Schltr.) Nicholas & Goyder**

A. undulata L. = ***Xysmalobium undulatum*** **(l.) Ait.f.**

A. undulata sensu Murr. = ***Pachyacris crispa*** **(L.) Nicholas & Goyder var. *crispa***

A. valida (Schltr.) Schltr. = ***Pachycarpus asperifolius*** **Meisn.**

A. velutina (Schltr.) Schltr. = ***Aidomene velutina*** **(Schltr.) Nicholas & Goyder**

A. vestita Hook. = ***Gomphocarpus cancellatus*** **(Burm.f.) Bruyns**

A. vexillare (E. Mey.) Schltr. = ***Pachycarpus vexillaris*** **E. Mey.**

A. vicaria N.E. Br. = ***Pachycaris vicaria*** **(N.E. Br.) Nicholas & Goyder**

A. villosa Mill. *nomen confusum*

A. woodii (Schltr.) Schltr. = ***Pachyacris woodii*** **(Schltr.) Nicholas & Goyder**

A. xysmalobioides Hilliard & Burtt = ***Pachycaris transita*** **Nicholas & Goyder**

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APPENDIX TO
CHAPTER 4.2

ASCLEPIADACEAE

435. Asclepias oreophila A. Nicholas, **species nova** *A. cucullatae* (Schltr.) Schltr. affinis sed inflorescentia plerumque solitaria terminali (nec plerumque inflorescentiis pluribus ex axillis foliorum superiorum), floribus majoribus, lobis coronae c.8–11mm (nec c.6–7mm) longis, lobis coronae margine exteriore vix interiori altiore columnam staminalem haud superantibus et uno e pare dentium interiorum in cavitatem inflexo; (in *A. cucullata* lobis coronae margine exteriore interiori distincte altiore et saepe columnam staminalem superantibus, marginibus dentium interiorum ad se appressis).

Herba perennis; caules 5–23cm alti, solitarii vel duo e caudice, erecti, parce pubescentes. *Folia* c.25–90 × 1·5–7mm, ascendentia, linearia vel anguste elliptica, acuta, ad basin anguste cuneata, subsessilia, marginibus revolutis, vel supra hispidula intra pilis ad costam restrictis vel omnino glabra. *Inflorescentiae* umbelliformes, 3–5-florae, pedunculo foliis breviore, saepe solitariae terminales interdum altera ex axilla folii superioris vel ramulum brevem terminante. *Flores* 8–12 × 13–18mm. *Calyx* lobis c.3–4 × 1mm lanceolatis extra hispidis. *Corolla* catilliformis, fere ad basin divisa; lobi 8–11 × 5·5–7mm, late elliptici, intus glabri, extra tenuiter vel dense pubescentes, margine ciliati, intus albi vel eburnei, extra albi vel ochroleuci vel griseo-brunnei roseo-violaceo- vel purpureo-notati. *Coronae* lobi 3·2–4·5 × 2–3·5mm, virides, purpureo-brunneo- vel violaceo-maculati, complicato-cucullati, naviculiformes, sinu saccato, carina sordide violacea brunnea vel viridiuscula, appendicibus proximalibus luteo-viridibus uno e dentibus duobus in cavitatem inflexo. *Columna staminalis* 4–5mm; appendices antherae albi, ovati, 1–1·3 × 1·2–1·7mm, supra gynostegio albo vel pallide viridi inflexi; fissura alaris 1·2–1·5mm longa. *Pollinia* triangularia, c.0·76–0·88 × 0·44–0·52mm. Fig. 1.

Type: Natal, Mpendhle distr., 2929 BC, Kamberg area, Storm Heights, c.7000ft, 14 xii 1978, *Hilliard & Burtt* 11703 (NU holo., E iso.).

NATAL. Estcourt distr., 2929 BB, Highmoor State Forest, *Killick & Vahrmeijer* 3579 (PRE). Mpendhle distr., 2929 BC, 'Redruth', c.6900ft, 5 xii 1972, *Wright* 1323 (NU); 'Allendale', 24 i 1978, *Hilliard & Burtt* 11245 (E, NU); Mulangane ridge above Carter's Nek, 7000–7300ft, 30 xi 1983, *Hilliard & Burtt* 16926 (E, NU); 2929 CB, 'River View', hillside W of

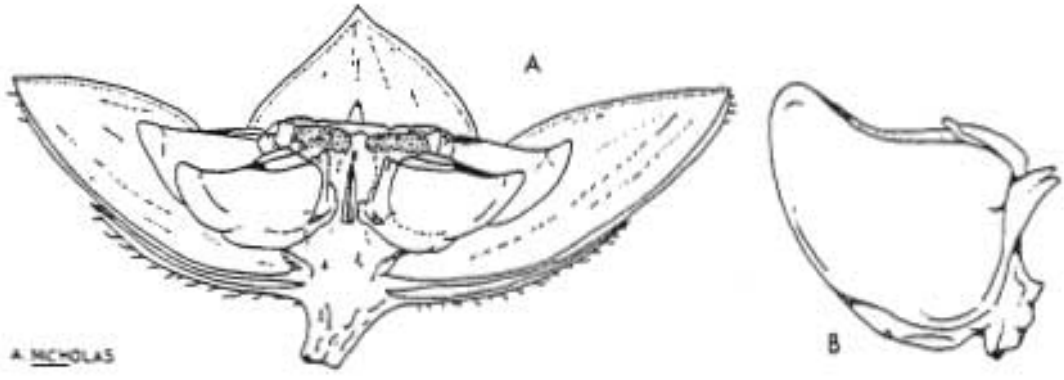


FIG. 1. *Asclepias oreophila*. A, flower with part of the calyx and corona cut away (×4); B, corona lobe (×8). Both from *Hilliard & Burtt* 11703.

Vergelegen, 16 xii 1978, *Stewart* 2083 (NU). Underberg distr., 2929 CB, Gxalingenwa valley, 6500ft, 10 xii 1983, *Hilliard & Burtt* 17173 (E, NU); 'Lakes' cave area, c.7100ft, 13 xii 1982, *Manning, Hilliard & Burtt* 15984 (E, NU); Sipongweni plateau, 5 xii 1978, *Cowan* 115 (NU); 2929 CA, Mlambonja valley, 6800ft, 5 i 1982, *Hilliard & Burtt* 14931 (E, NU); 2929 CC, Bushman's Nek pass, c.6000ft, 4 xii 1979, *L. & R. Davis* 193 (NU); Bushman's Nek, slopes N of hotel, 29 xii 1982, *Manning* 319 (NU). TRANSKEI. 3028 BB, Ramatseliso's Gate, *Boardman* A12 (PRE); ibidem, *Boardman* 184 (PRE).

This attractive asclepiad has so far been found only along the face and in the foothills of the southern Natal and Transkei Drakensberg from Highmoor State Forest to Ramatseliso's Gate, at altitudes between 1700 and 2200m. The specific epithet *oreophila* (mountain loving) refers to this mountainous distribution. The plant grows in grassland, usually amongst stones, and flowers between November and January. Of all the southern African species of *Asclepias*, *A. oreophila* most closely resembles *A. cucullata*, and if keyed out using N. E. Brown's key (in Thiselton-Dyer, *Fl. Cap.* 4(1):664–670, 1907) runs out near to it. The corona-lobes of both species superficially resemble each other: however those of *A. oreophila* are more complex. There are also important vegetative differences as well as differences in flower size and colour (see diagnosis). Although a phylogenetic relationship is possible, it is not close.

A new species and a new combination of *Asclepias* (Asclepiadaceae) in southern Africa

A. NICHOLAS*

Keywords: *Asclepias*, Asclepiadaceae, new combination, new species, southern Africa, taxonomy

ABSTRACT

A new species is described: *Asclepias* **gordon-grayae** A. Nicholas, sp. nov. and a new combination is made: *Asclepias* **compressidens** (N.E. Br.) A. Nicholas, comb. nov.

UITTREKSEL

'n Nuwe spesie word beskryf: *Asclepias* **gordon-grayae** A. Nicholas, sp. nov. en 'n nuwe kombinasie word gemaak: *Asclepias* **compressidens** (N.E.Br.) A. Nicholas, comb. nov.

1. **Asclepias gordon-grayae** *A. Nicholas*, sp. nov. *A. patenti* N.E. Br. et *A. praemorsae* Schltr. affinis; differt a *A. praemorsa* appendicibus antherae brevibus et a *A. patenti* margine supero coronae prope extremum distale fisso.

Herba perennis. *Caudex* profundus, lignosus. *Caulis* unicus, erectus, gracilis, pubescens. *Folia* expansa, anguste lanceolata ad linearia, 34–128 × 2,25–(–35) mm. *Inflorescentia* umbellata, ad nodos et terminalis, semi-pendens. *Flores* rosei ad eburnei. *Corolla* expansa usque ascendens, lobis ovatis, basi connatis. *Corona* cucullata-saccata, appendicibus proximalibus dentatis, subfalcatis, extremo distali coronae brevissimo et obtuso, sinus coronae saccati, carina coronae rotundata. *Appendices* antherae ovatae usque ellipticae, 1,0–1,4 × 0,5–1,0 mm. *Apex styli* truncatus. *Pollinia* hemitrullata usque hemipyriformes, 0,68–0,92 × 0,40–0,52 mm. *Fructus* fusiformis, apice rostrato.

TYPE.—2832 (Mtubatuba): (–AB) Natal, Zululand, St Lucia, Eastern Shores State Forest, Simbonvini vlei, 20 m (65 ft) alt., March 1982, *Nicholas 1285* (PRE, holo.; CPF, K, NH, MO).

Perennial herb with woody, semi-swollen, deep-seated underground organs. *Stem* single, erect, 240–750 mm high. *Leaves* spreading, narrowly lanceolate to linear, occasionally upper leaves falcate, 34–128 × 2–25 (–35) mm, apex acute to acuminate, base minutely auriculate to minutely hastate; petiole 0,6–1,3 (–2,0) mm long. *Inflorescence* umbelliform, semipendulous, axillary and terminal, 1–4 per plant, 4–6 (–9)-flowered; peduncles 7–14 (–24) mm long. *Flowers* 6–14 × 4,5–8,0 mm, pink or pale pink to cream; pedicel 7–20 mm long. *Sepals* lanceolate, occasionally triangular or narrowly ovate, 2,2–3,4 × (0,7–)1,4–2,1 mm. *Corolla* spreading to ascending; petals connate at base, ovate, apex acute, 6,4–7,7 × 3,2–4,9 mm, white, cream or pink in centre and near apex, margins white to pale pink, abaxial surface glabrous, margins minutely scabrous. *Corona lobes* fused to staminal tube 0,3–0,5 mm above corolla, saccate or cyathiform, 1,3–2,6 × 2,3–3,3 mm, white to cream with pink keel. Upper proximal ends extended into 2 long, dentate, subfalcate appendages 1,5–2,8 × 0,4–0,8 mm, level with style apex. 2 tooth- or wing-like flaps present below appendages on proximal margin. Upper margin oblique to style apex, proximal end usually higher than distal end, which is sometimes raised into a short, blunt projection deeply cleft at apex, cleft running a short distance along rounded keel. *Staminal column* 2–3 mm high; alar fissure 1,2–2,0 mm long; anther wings curvirostrate, 1,2–2,0 × 0,5–0,9 mm; anther appendages ovate to elliptic, 1,0–1,4 × 0,5–1,0 mm, membranous, white, decumbent on style apex. *Style apex* truncate, 1,5–3,0 mm wide. *Pollinia* hemitrulloid to hemipyriform, 0,68–0,92 × 0,5–0,52 mm; translator arms 0,2–0,32 mm long; corpusculum 0,28–0,4 × 0,5–0,52 mm. *Fruits* fusiform, ±65 × ± 10 mm, puberulous. Figure 1.

NATAL.—2831 (Nkandla): Ngoye Forest Reserve (–DC), *Gordon-Gray 6191* (NU), *Hilliard 2699* (NH, NU), *Huntley 624* (NU), *Nicholas 1074* (NU), *Stewart 2155* (NU), *Stirton 466* (PRE), *Strey 6106* (NH, NU), *Wood 5678* (NH), *10823* (BOL, SAM). 2832 (Mtubatuba): St Lucia (–AB), *Cawood 141* (CPF), *Nicholas 1285* (CPF, K, MO, NH, PRE); St Lucia (–AD), *Crundall s.n. (PRE 51584)*, *Pooley 1819* (NU). 2930 (Stanger): Gingindlovu (–BA), *Wood 10828* (SAM).

*Asclepias gordon-grayae*** is endemic to coastal Zululand where it grows in boggy situations. This species has been named in honour of Professor K. D. Gordon-Gray who has collected extensively (particularly in Natal) and who for many years lectured in taxonomy at the University of Natal, Pietermaritzburg. Professor Gordon-Gray has through her many publications and her teaching of taxonomy made a positive contribution to the knowledge of the southern African flora. *A. gordon-grayae* has in the past been confused with *A. patens* N.E.Br. with which it has many affinities. Vegetatively

* Botanical Research Institute, Private Bag X101, Pretoria 0001.

** In Nicholas (1982) the manuscript name *A. gracilicaulis* was used (in reference to the long, thin, wavy stem of this species). This name was never validly published and has been dropped here in favour of the name *A. gordon-grayae*.

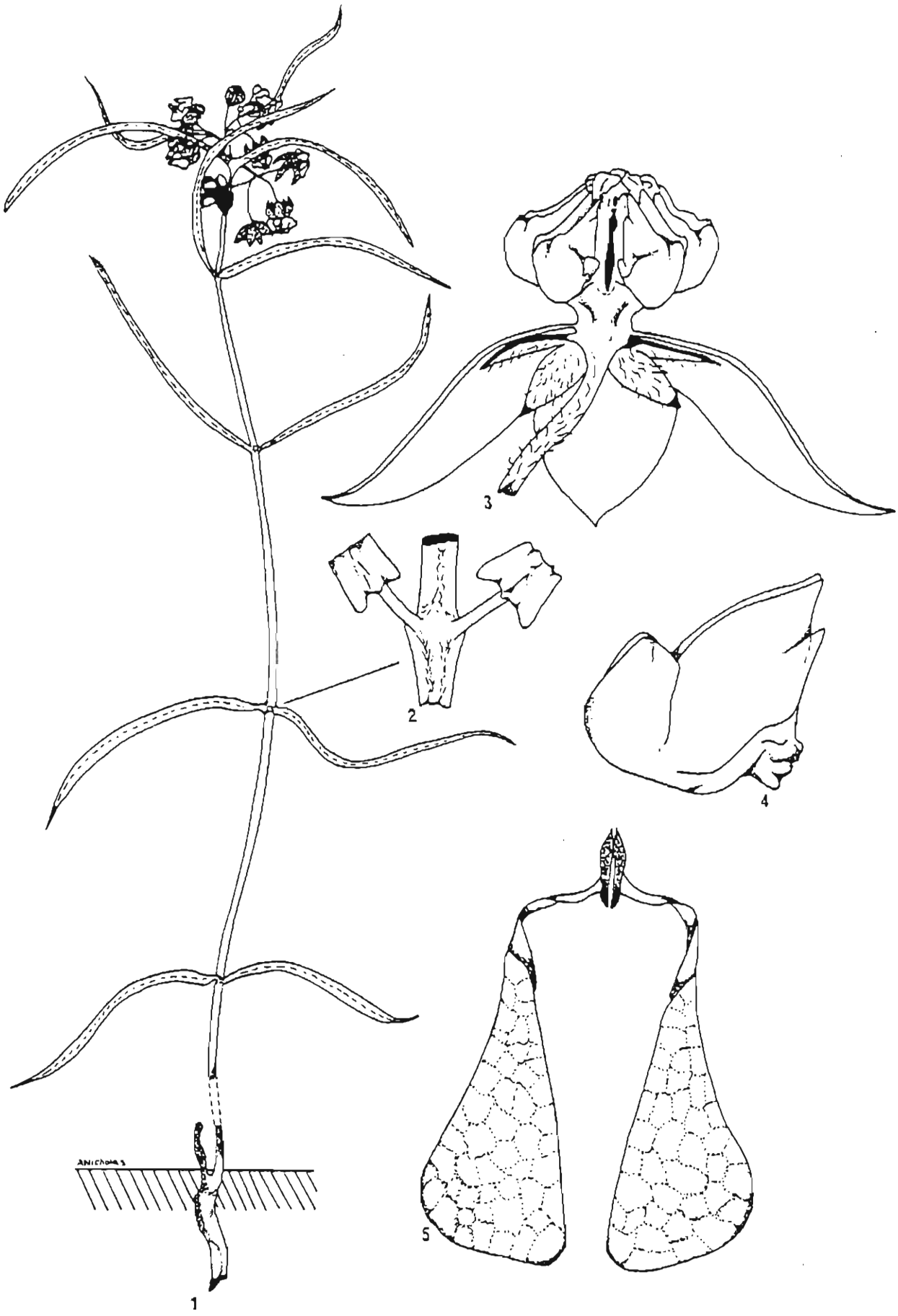


FIGURE 1.—*Asclepias gordon-grayae*. 1, flowering plant, × 0.25, *Edwards s.n.* (BOL); 2, node showing bifariously arranged hairs and leaf bases, × 4, *Gordon-Gray 6191* (NU); 3, flower, × 7, *Stewart 2155* (NU); 4, corona lobe, side view, × 3, *Stewart 2155* (NU); 5, pollinarium, × 130, *Stewart 2155* (NU).

tell these two species apart. However, there are marked differences in flower colour, corona lobe size and shape, anther appendage size and shape and pollinia width (Figure 2; Table 1). There are also differences in distribution (Figure 3) and in habitat preference. The number, degree and consistency of these and other differences are diagnostically important and help separate *A. gordon-grayae* from its two closest relatives: *A. patens* and *A. praemorsa* Schltr. (Figures 2, 4 & 5; Table 1). *A. gordon-grayae* may be found growing at altitudes between 30 and 900 metres and flowers between September and April, with a peak period in December.

KEY TO *ASCLEPIAS GORDON-GRAYAE* AND ITS CLOSEST ALLIES

1a Anther appendages 1,7–2,5 × 1,0–1,6 mm ..... *A. praemorsa*

1b Anther appendages 0,5–1,4 × 0,5–1,0 mm.

2a Upper coronal edge entire; southern Natal and Transkei .. .. *A. patens*

2b Upper coronal edge cleft near the distal end; Zululand only ..... *A. gordon-grayae*

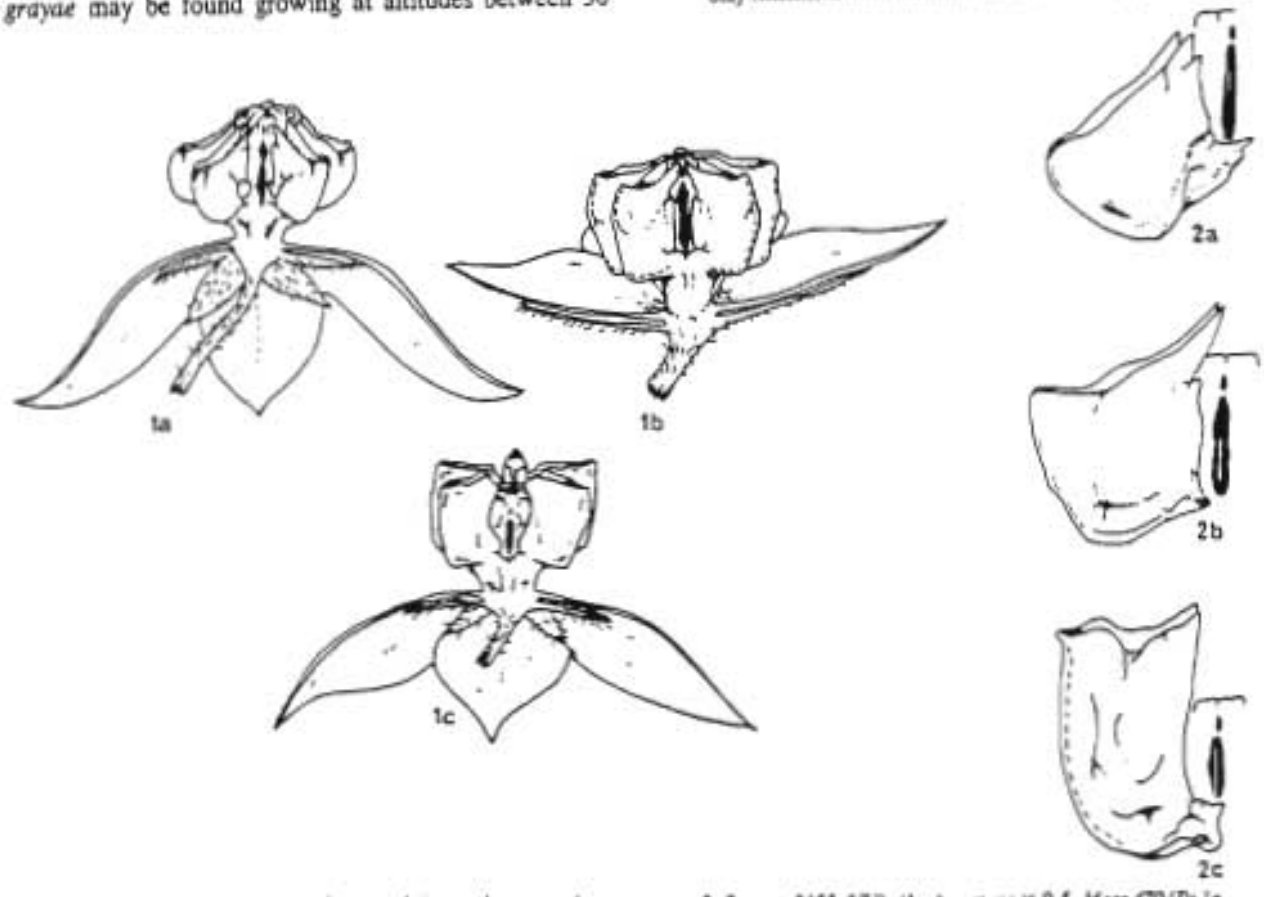


FIGURE 2.—A comparison of the flowers of: 1a, *Asclepias gordon-grayae*, × 5, *Stewart 2155* (NU); 1b, *A. patens* × 9,5, *Moss 470* (D); 1c, *A. praemorsa* × 8, *Strey 6902* (NH). A comparison of the corona lobes of: 2a, *A. gordon-grayae*, × 4, *Strey 6106* (NU); 2b, *A. patens* × 10, *Gordon-Gray 961* (NU); 2c, *A. praemorsa* × 14, *Wood 1162* (NH).

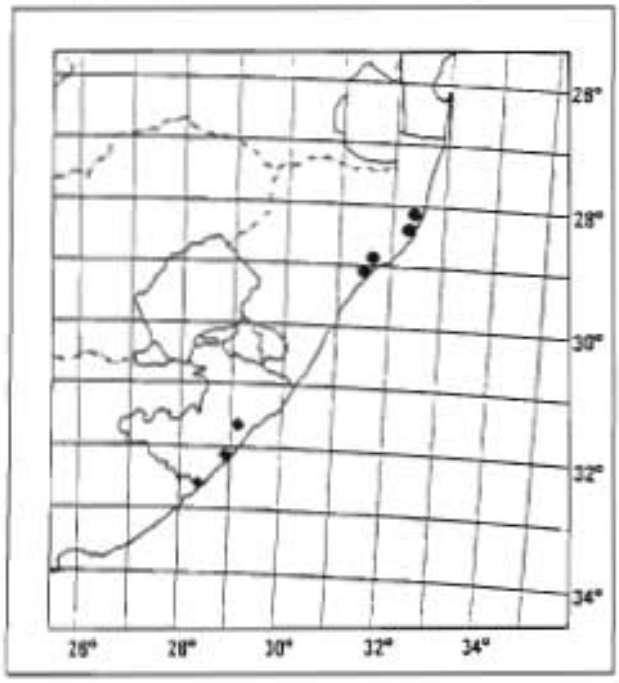


FIGURE 3.—Map showing comparative distribution of *Asclepias gordon-grayae*, ● and *A. patens*, ◆.

2. **Asclepias compressidens** *(N.E.Br.) A. Nicholas*, comb. et stat. nov.

Asclepias navicularis (E. Mey.) Schltr. var. *compressidens* N.E.Br.: 683 (1908). Type: Cape, 3225 (Somerset East): Cradock (–BA), *Cooper 1284* (K, lecto.!; PRE!).

Perennial herb with woody, swollen, deep-seated underground organ. *Stems* 1–6 per plant, decumbent. *Leaves* spreading to ascending, linear, occasionally narrowly lanceolate or falcate, 15–85 × (1,5–)2,0–4,5 mm, apex acuminate, base petiolate, occasionally trullate, margins slightly revolute; petiole 1,5–3,0 mm long. *Inflorescences* umbelliform, terminal, solitary, erect, 1–3 per plant, 4–9-flowered; peduncles 27–35 mm long. *Flowers* ±1 × 1,1–1,4 mm, pink to light grey. *Sepals* ascending, lobes lanceolate, 6,6–6,8 × 1,2–2,0 mm. *Corolla* ascending, petals lanceolate to ovate, connate at base, 10,5–11,8 × ±5 mm, margins slightly revolute, occasionally sinuate, central vein prominent, colour inside lilac-green, outside purple-green, abaxial surface glabrous, adaxial surface canescent. *Corona lobes* arising from base of staminal column, erect, cucullate, saccate, 3,8–4,2 × 1,7–2,0 mm, upper proximal ends forming two obtuse almost triangular shoulders level with middle of anther-wings, proximal margins concave to

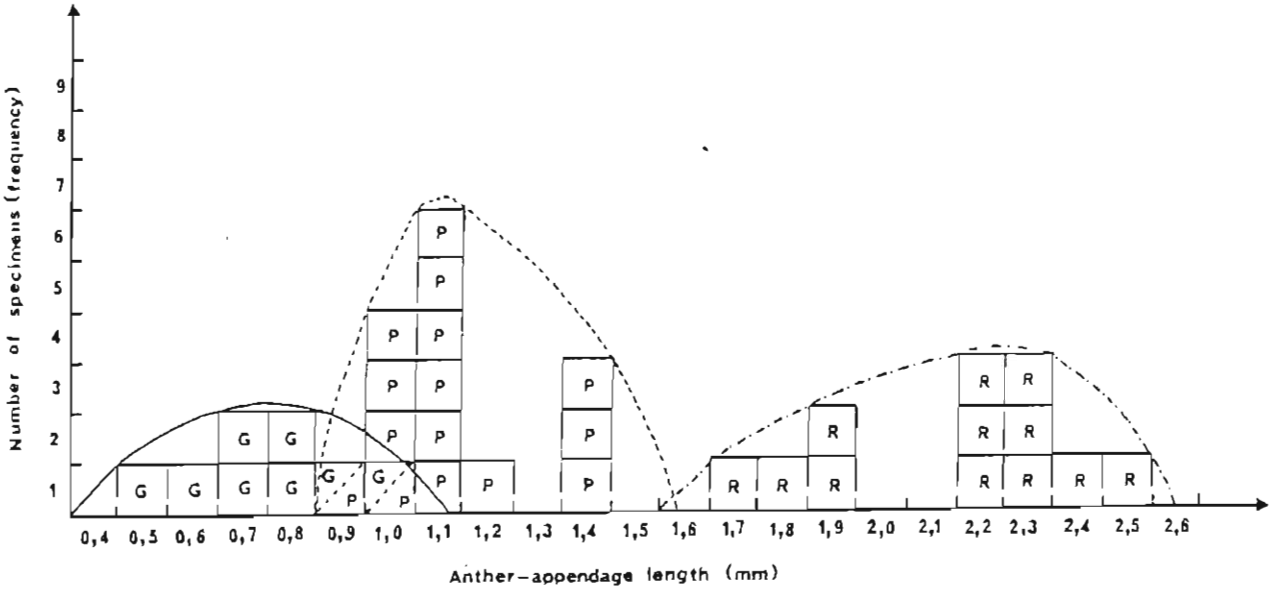


FIGURE 4.—Histographic comparison of anther appendage length in *Asclepias gordon-grayae*, G; *A. patens*, P; and *A. praemorsa*, R.

lobe base and folded to meet, upper margin entire, curving to form a deltoid, obtuse distal lobe end. Keel dipping near upper distal end, convex and narrow at lobe base. Sinus a narrow central channel, 3,8–4,2 mm long, with tongue-like appendage. *Staminal column* 3–4 mm long; alar fissure 1,7–1,8 mm long; anther-wings 1,7–1,8 × ± 0,7 mm, concave near apex with small notch on margin; anther appendages tongue-like, ovate, 1,0–1,3 × 1,1–1,2 mm, decumbent. *Style apex* truncated to slightly conical, 2,3–2,8 mm wide. *Pollinia* clavate to lacrimiform, 1,5–1,6 × ±0,56 mm; translator arms 0,48–0,56 mm long; corpusculum 0,16–0,24 mm wide. Figure 6.

NATAL.—3126 (Queenstown): Queenstown (–DD), *Acocks 17936* (PRE). 3225 (Somerset East): Cradock (–BA), *Cooper 1284* (K, PRE). 3326 (Grahamstown): Alexandria (–CB), *Acocks 17872* (PRE); Southwell (–DA), *Bayliss 4631* (PRE). 3327 (Peddie): near East London (–BB), *Wood 1995* (K).

Although closely allied to *Asclepias navicularis*, *A. compressidens* can be distinguished from it by a number of important characters (Figure 6; Table 2). Also *A. navicularis* has a distribution centred on the coastal region of the eastern Cape, whereas *A. compressidens* may also be found further inland (Figure 7) and at higher altitudes. The specific epithet refers to the compressed tongue-like appendage that lies within the corona lobe sinus. *A. compressidens* and *A. disparilis* N.E. Br. possess similar corona lobes, but in *A. disparilis* the distal corona lobe appendage is slightly elongated and there is a transverse shelf-like flap of tissue within the coronal sinus just above the middle point of the lobe; the leaves are also shorter and broader (Table 3). *A. compressidens* is found at an altitude of between 30 to 140 metres and flowers from November to February. It is found growing in grassland and is said to be rare.

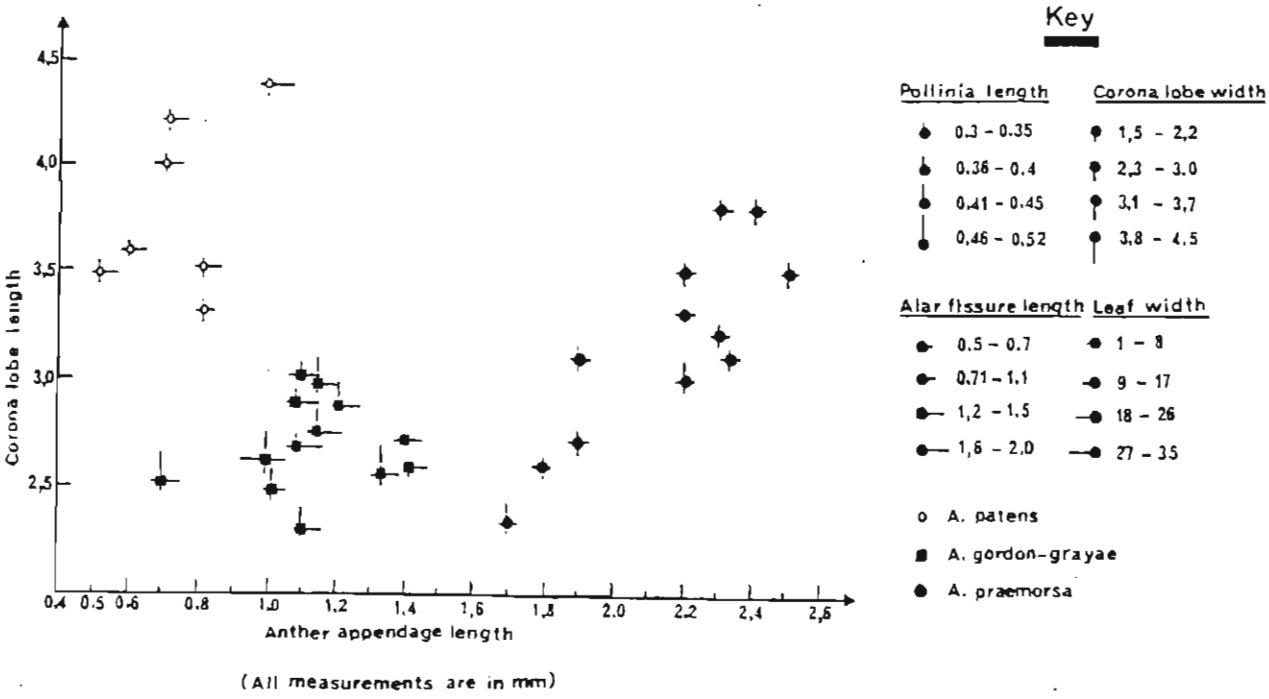


FIGURE 5.—Scatter diagram: a comparison of a number of characteristics in *Asclepias gordon-grayae*, *A. patens* and *A. praemorsa*.

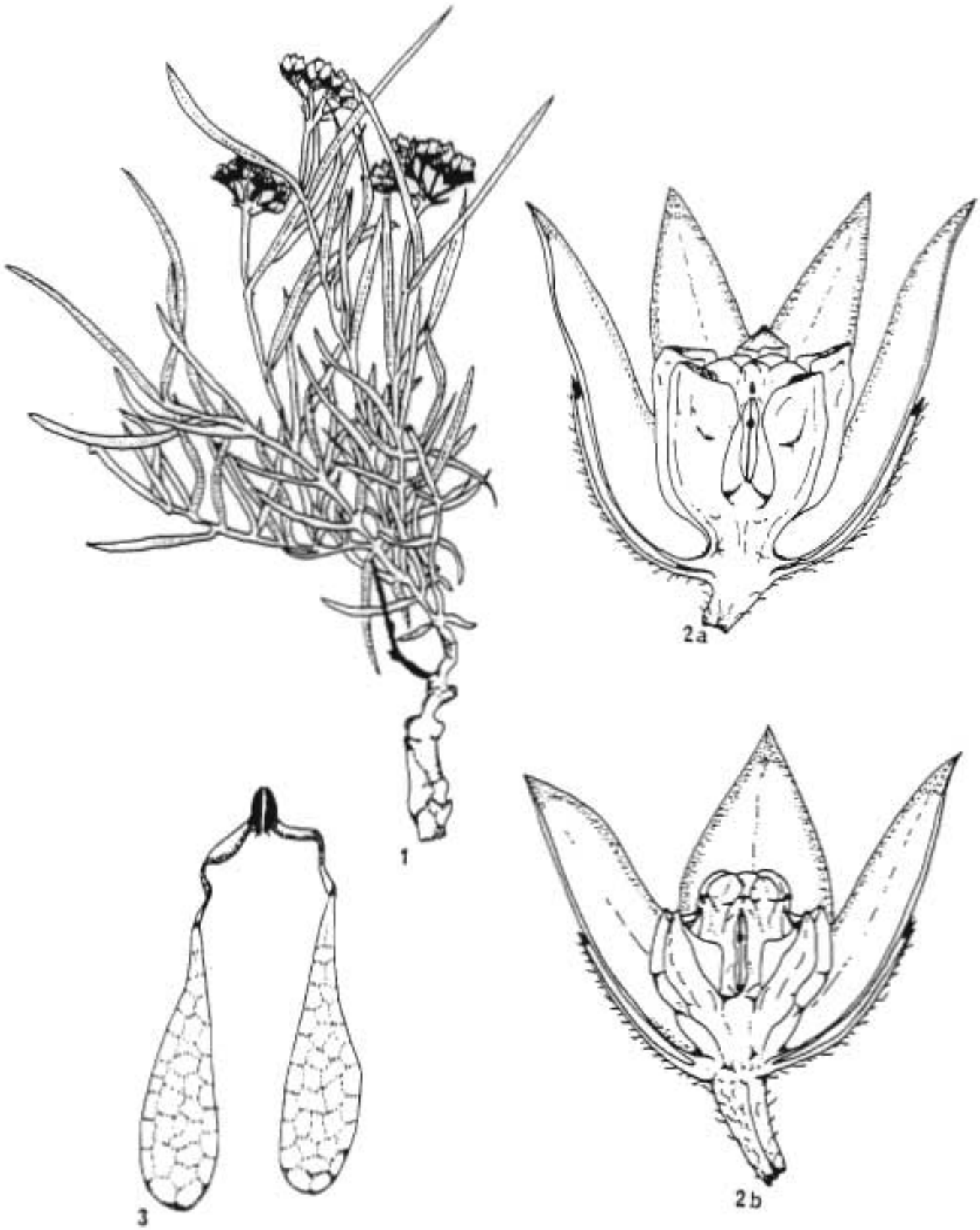


FIGURE 6.—*Asclepias compressidens*. 1, flowering plant, × 0,6, *Acocks 17936* (PRE); 2b, flower, × 6,5, *Rogers 12762a* (BOL); 3, pollinarium, × 120, *Rogers 12764a* (BOL). A comparison of the flowers of: 2a, *A. navicularis* × 8, *Comins 1355* (PRE); 2b, *A. compressidens*, × 6,5, *Rogers 12764a* (BOL).

TABLE 1.—A comparison of the differences separating *Asclepias gordon-grayae*, *A. patens* and *A. praemorsa*

Character	*A. gordon-grayae*	*A. patens*	*A. praemorsa*
Leaf width	2–25(–35) mm	1–9(–11) mm	1–3 mm
Corona lobe upper margin	May have a distinct dip near the distal end oblique to the style apex	Entire, undulating, slightly oblique to the style apex	Entire, truncated, level with the style apex
Corona: relationship to style apex	Proximal appendages tooth-like reaching, but not projecting over, the style apex	Proximal appendages tooth-like; projecting over the style apex	No true proximal appendages, corona higher than the style apex, but not projecting over it
Corona lobe (height)	1,3–2,6 mm	2,4–3,4 mm	2,2–3,8 mm
Corona lobe (width)	2,3–3,3 mm	3,0–4,4 mm	1,8–2,8 mm
Alar fissure (length)	1,2–2 mm	1,0–1,7 mm	0,6–1,1 mm
Anther appendage (shape)	Ovate to elliptic	Triangular to widely ovate	Oblong or strap-like
Anther appendage (length)	1,0–1,4 mm	0,5–1 mm	1,7–2,5 mm
Pollinia (length)	0,68–0,92 mm	0,8–0,92 mm	0,56–0,68 mm
Pollinia (width)	0,4–0,52 mm	0,32–0,4 mm	0,32–0,48 mm
Habitat	Mountain plateau marsh lands and boggy vleis	Grasslands on mountain slopes	Mountain grasslands on Table Mountain sandstone
Distribution	Zululand–Ngoye to St Lucia	Transkei–Kentani to Port St Johns	Transkei and southern Natal–Umtata to Pinetown

TABLE 2.—The main diagnostic differences between *Asclepias compressidens* and *A. navicularis*

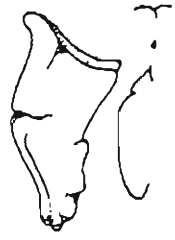
Character	*A. compressidens*	*A. navicularis*
Corona lobe shape		
Level of corona lobe in relation to the style apex	Shorter than the style apex	Level with the style apex
Proximal corona lobe end in relation to the distal end	Lower than the distal end of the lobe	Level with the distal end of the lobe
Corona lobe sinus	Tongue-like flap inside	Transverse flap-like shelf inside
Anther-wing (outer edge)	Squared	Round
Notch on anther-wing margin	Near the top	Near the base
Pollinia	Claviform or lacrimiform	± Rectangular

TABLE 3.—The main diagnostic differences found between *Asclepias compressidens* and *A. disparilis*

Character	*A. compressidens*	*A. disparilis*
Leaf length	15–18 mm	12–37 mm
Leaf width	2–4,5 mm	3–9 mm
Distal appendage of corona lobe	Not produced	Slightly produced
Corona lobe sinus	Tongue-like projection	Transverse shelf-like flap

KEY TO *ASCLEPIAS COMPRESSIDENS* AND ITS CLOSEST ALLIES

1a Corona lobe sinus without transverse flap of tissue near apex, compressed tongue-like appendage present ..... *A. compressidens*

1b Corona lobe sinus with transverse flap of tissue near apex, no compressed tongue-like appendage present:

2a Upper distal corona lobe edge level with style apex; leaf width at lamina base 1–5 mm ..... *A. navicularis*

2b Upper distal corona lobe edge level with middle of anther-wing (not level with style apex) leaf width at lamina base 3–9 mm ..... *A. disparilis*

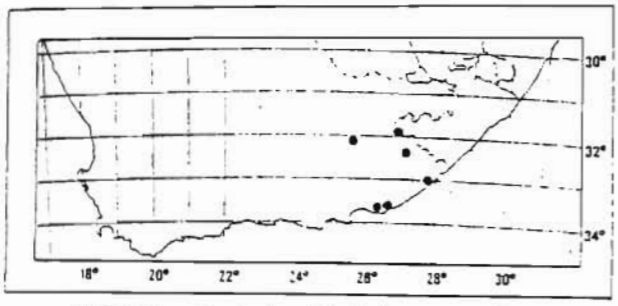


FIGURE 7.—Distribution of *Asclepias compressidens*.

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I would like to thank the Directors and staff of the following herbaria: BOL, CPF, GRA, J, K, NBG, NH, NU, P, PRE, RUH, SAM and TCD for the loan of herbarium specimens; the Director and staff of the Department of Environment Affairs and the Head and staff of the Department of Botany, University of Natal, Pietermaritzburg who made facilities available to me for the study; Mr M. Lambert, Department of Classical Civilization, University of Natal, Pietermaritzburg for help with the Latin description of *Asclepias gordon-grayae*.

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Bothalia 17,1: 29–43 (1987)

Notes on African plants

VARIOUS AUTHORS

ASCLEPIADACEAE

NOTES ON *ASCLEPIAS DIPLOGLOSSA*, *A. COGNATA* AND *A. FLAVA*

A. flava N.E.Br. and *A. cognata* N.E.Br. have in the past been erroneously considered conspecific with *A. diploglossa* (Turcz.) Druce. Although allied, these three taxa are morphologically distinct.

South African herbaria have, for some years, treated *A. flava* N. E. Br. and *A. cognata* N.E.Br. as synonyms of the older *A. diploglossa* (Turcz.) Druce. This is due to the misinterpretation of a letter sent from Kew to the Botanical Research Institute in 1963. Marais, who was then the South African Liaison Officer at Kew, mentions in this letter that 'Mr Bullock regards both *A. flava* N.E.Br. and *A. cognata* N.E.Br. as conspecific with *A. diploglossa*'. He does, however, state earlier in the same letter 'As far as I know *A. flava* N.E.Br. has not been sunk under *A. diploglossa*'. This was, and still is the case as Bullock did not publish his opinions. Despite Marais's warning that these reductions to synonomy were not validly published, Bullock's suggestions were unfortunately followed and to all intents and purposes *A flava* and *A. cognata* became synonyms under *A. diploglossa*. This situation has recently been rectified in Gibbs Russell *et al.* (1984) and further details are given here.

Although vegetatively similar, close examination shows all three species to be distinct taxonomic entities with very different floral morphologies (Figures 1 & 2; Table 1).

KEY TO *ASCLEPIAS DIPLOGLOSSA* AND ITS ALLIES

1a Proximal corona lobe appendages projecting over style apex ..... *A. cognata*

1b Proximal corona lobe appendages not projecting over style apex:

2a Corona lobes with arm-like proximal appendages crossing over each other and reflexing back into coronal sinus, appendages are below style apex and level with anther-wings ..... *A. flava*

2b Corona lobes without true proximal appendages, proximal ends of corona forming dentate to obtuse (but protruding) shoulders level with top of style apex ..... *A. diploglossa*

Representative specimens

Asclepias diploglossa *(Turcz.) Druce*

NATAL.—2730 (Vryheid): Wakkerstroom (–AD), *Devenish 759* (NH, PRE). 2828 (Bethlehem): Royal Natal Park (–DB), *Acocks & Hafstrom 11205* (PRE). 2829 (Harrismith): Van Reenen (–AD), *Wood 11205* (PRE). 2929 (Underberg): Giants' Castle (–AB), *Symons 188* (PRE); Highmoor State Forest (–BC), *Killick & Vahrmeijer 3583* (PRE); Sani Pass (–CB), *Lugillies 109* (NU); Bushman's Nek (–CC), *Killick & Vahrmeijer 3969* (PRE); Garden Castle Nature Reserve (–CD), *Hilliard & Burtt 7866* (NU); Mpendle (–DB), *Moll 1481* (PRE); Glengariff (–DD), *Rennie 488* (NU). 2930 (Pietermaritzburg): Greytown (–BA), *Wylie s.n. (NH 21644)*; Inanda (–DB), *Groom s.n. (NH 4106)*.

TRANSKEI.—3028 (Matatiele): Ramatseliso's Gate (–BB), *Boardman 186* (PRE).

CAPE.—3227 (Stutterheim): Hogsback (–CA), *Compton 1421* (NBG); Dohne Hill (–CB), *Sim 1237* (SAM). 3326 (Grahamstown): near Grahamstown (–BC), *Glass 1503* (SAM).

Asclepias flava *N.E.Br.*

NATAL.—2929 (Underberg): Underberg (–CD), *Over 3744* (NH); Sunset (–DA), *Rennie 275* (NU); Mpendle (–DB), *Hunsley 625* (NH); Nkonzo State Forest (–DD), *Nicholas & Norris 1159* (CPF, NH, PRE). 2930 (Pietermaritzburg): Howick (–AC), *Haygarth s.n. (SAM 8378)*; Blinkwater Range (–AD), *Nicholas 1019* (NU); Zwaartkop (–CB), *Wood 11219* (SAM); Byrne (–CC), *Stewart 2023* (NU); Dargle (–DB), *Nicholas & George 1040* (CPF, K, MO, NH, NU). 3030 (Port Shepstone): Ixopo (–AA), *Shirley s.n.* (NU).

TRANSKEI.—3029 (Kokstad): Mt Currie (–AD), *Tyson 1686* (BOL, PRE); Malowe (–BD), *Tyson 1086* (BOL, SAM); Vaal Bank (–CB), *Haygarth s.n. (NH 4230)*; Ngeli Forest (–DA), *Coleman 813* (PRE); Fort Donald (–DC), *Tyson 1660* (SAM). 3128 (Umtata): Bazija (–CB), *Baur 556* (SAM).

CAPE.—3326 (Grahamstown): Grahamstown (–BC), *Glass 1503* (NBG).

Asclepias cognata *N.E.Br.*

NATAL.—2929 (Underberg): Fort Nottingham (–BD), *Hilliard & Burtt 9056* (NU); Bamboo Mountain (–CB), *Grice s.n.* (NU); Garden Castle Nature Reserve (–CD), *Hilliard & Burtt 13767* (NU); Mpendle (–DB), *Hilliard & Burtt 13856* (NU).

TRANSKEI.—3029 (Kokstad): Ensikeni (–BA), *Haygarth s.n. (NH 15735)*; Mount Insizwa (–CD), *Schlechter 6496* (BOL, NH); Ngeli Mountain (–DA), *Hilliard & Burtt 5769* (NH, NU).

CONCLUSIONS

A. flava and *A. cognata* have never been validly reduced to synonomy under *A. diploglossa* and are, as outlined by Brown (1908), distinct species allied to, but separable from *A. diploglossa*.

ACKNOWLEDGEMENTS

I would like to thank the Director and staff of the following herbaria: BOL, CPF, GRA, J, K, NBG, NH, NU, P, PRE, RUH, SAM and TCD for the loan of herbarium specimens; the Head and staff of the Department

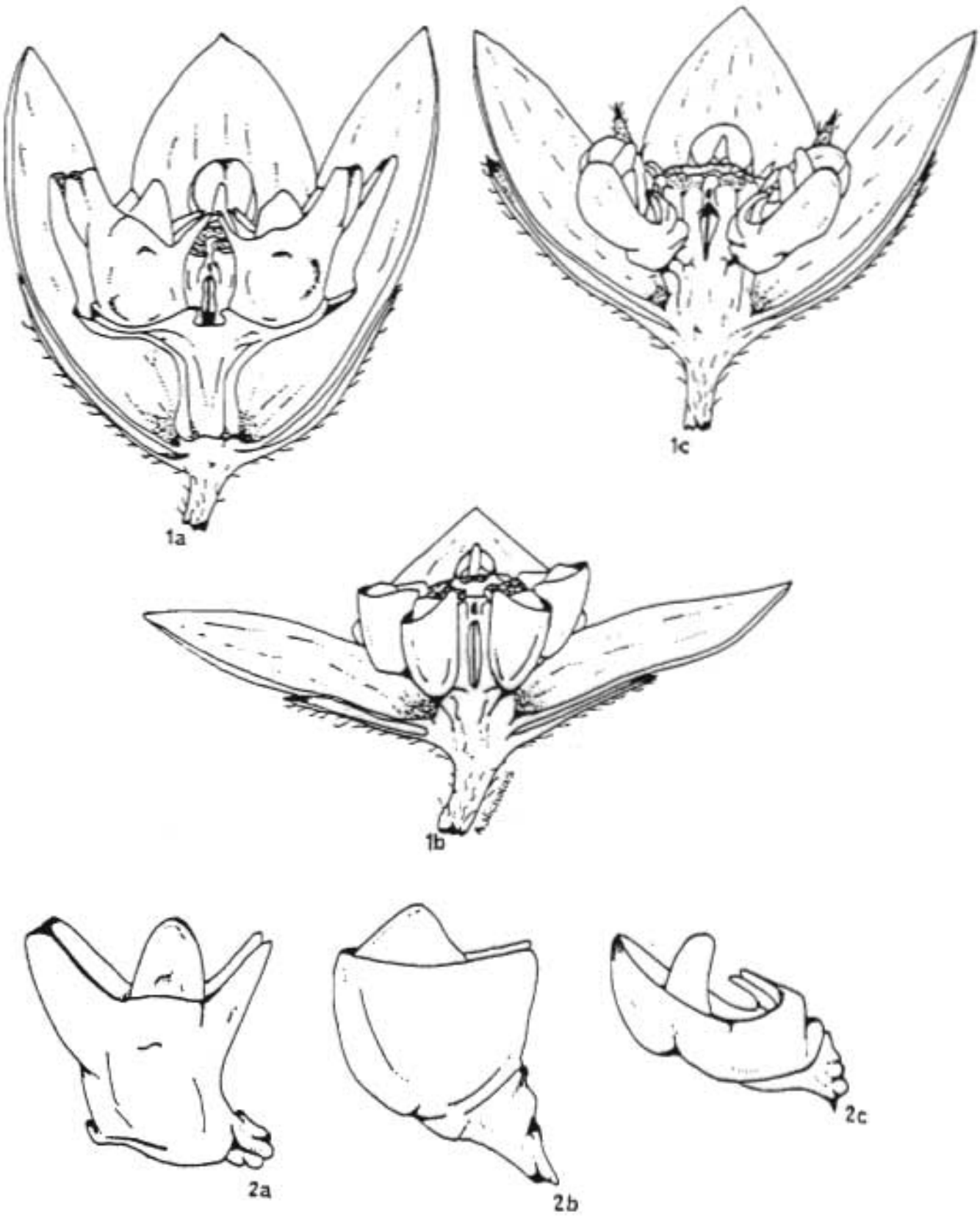

FIGURE 1.—Comparison of flower (1) and corona lobe (2) of *Asclepias* species. Structure in: 1a, *A. cognata*, × 10, *Hilliard & Burtt 9056* (NU); 1b, *A. diploglossa*, × 20, *Boardman A11* (PRE); 1c, *A. flava*, × 19, *Coleman 813* (PRE); 2a, *A. cognata*, × 17, *Hilliard & Burtt 9056* (NU); 2b, *A. diploglossa*, × 28, *Boardman A11* (PRE); 2c, *A. flava*, × 38, *Coleman 813* (PRE).

TABLE 1.—A comparison of *Asclepias cognata*, *A. diploglossa* and *A. flava*. All measures in mm

Character	*A. cognata*	*A. diploglossa*	*A. flava*
Leaf length	7–68	5–133	7–83
Petiole length	0–3	0–4	0–5
Inflorescence bract length	2.6–6.2	2.5–10	2.6–7.5
Peduncle length	3–92	0–95	4–175
Flower colour	Yellow, yellow & purple	Yellow, yellow & brown	Yellow-green
Flower width	7–17	6–13	5–8
Flower height	5–12	4–9	3–6
Sepal width	1–1.8	1–1.5	0.7–1.2
Petal length	5.8–10.5	4–7	3.5–5
Petal width	2.6–5.8	2.4–4.1	2–3.2
Corona lobe shape	Bonnet-like	Cup-like	Bowl-like
Corona lobe (sinus depth)	2.2–2.5	1.1–2	0.4–0.7
Proximal corona lobe appendage length	0.6–1.2	None	0.25–0.7
Coronal sinus appendage length	0.8–1.3	0.2–0.7	0.4–0.7
Alar fissure length	0.8–1.4	0.75–1.1	0.5–0.7
Anther appendage width	0.8–1.3	0.6–0.9	0.5–0.8
Style apex width	1.5–2.8	1.1–2.1	1.1–1.6
Translator-arm length	0.32–0.56	0.2–0.36	0.18–0.28
Corpusculum length	0.2–0.3	0.22–0.32	0.16–0.26
Pollinium length	0.72–0.96	0.68–0.84	0.48–0.68
Pollinium width	0.24–0.32	0.24–0.36	0.16–0.24

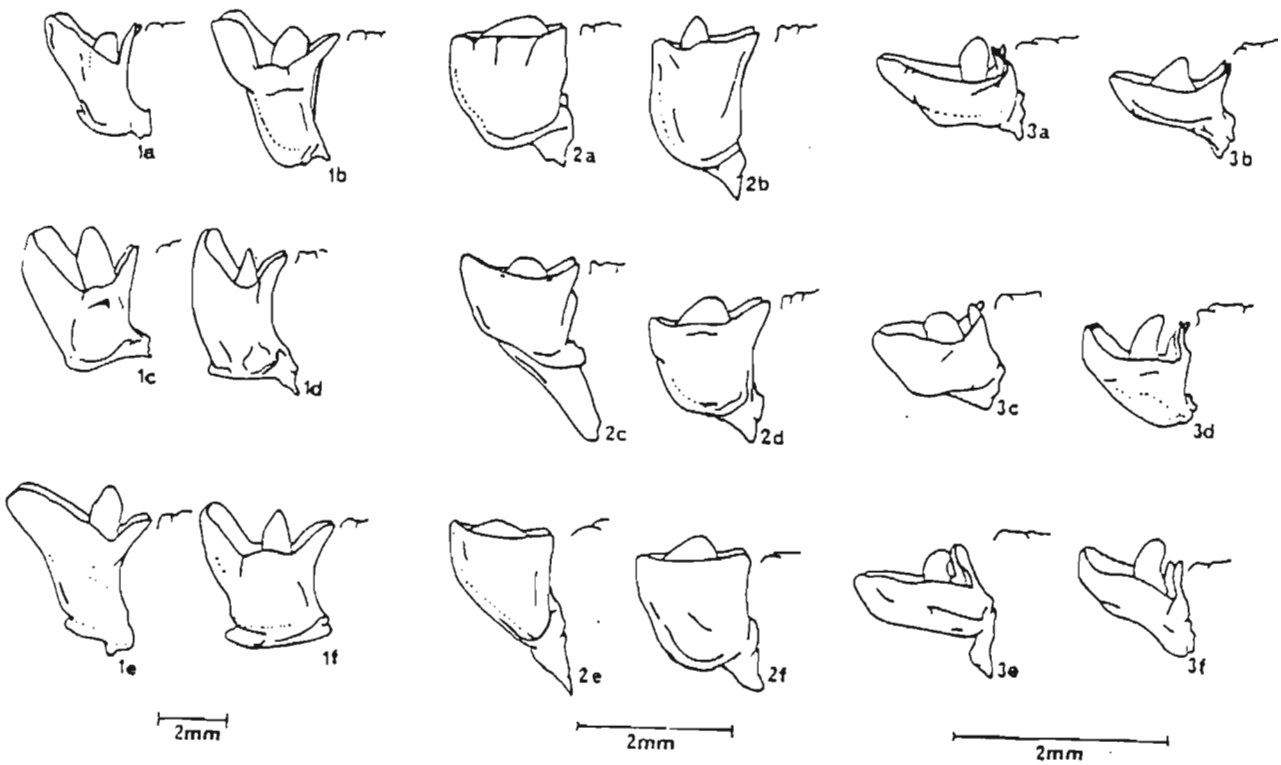

FIGURE 2.—A comparison of corona lobe variation. 1, *Asclepias cognata*: a, *Hilliard & Burtt 5769* (NH); b, *Haygarth s.n.* (NH 13661); c, *Hilliard & Burtt 13452* (NU); d, *Hilliard & Burtt 13767* (NU); e, *Haygarth s.n.* (NH 15735); f, *Hilliard & Burtt 13856* (NU). 2, *A. diploglossa*: a, *Grice s.n.* (NU); b, *Wylie s.n.* (NH 21644); c, *Devenish 759* (PRE); d, *Rennie 488* (NU); e, *Wood 11205* (PRE); f, *Barker 1421* (NBG). 3, *A. flava*: a, *Hilliard & Burtt 5839* (NU); b, *Baur 556* (SAM); c, *Glass 1503* (NBG); d, *Tyson 1660* (SAM); e, *Tyson 1686* (BOL); f, *Wood 11219* (SAM).

of Botany, University of Natal, Pietermaritzburg; and the Director and staff of the Department of Environment Affairs.

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A. NICHOLAS

Bothalia 22,1: 23–35 (1992)

Aspidonepsis (Asclepiadaceae), a new southern African genus

A. NICHOLAS* and D.J. GOYDER**

Keywords: *Asclepias*, Asclepiadaceae, *Aspidonepsis*, new genus, new species, southern Africa, taxonomy, *Unguilobium*

ABSTRACT

Aspidonepsis, an endemic southern African genus, is described and compared to the closely allied genus *Aspidoglossum*. This newly described genus is composed of two subgenera, Aspidonepsis and Unguilobium, consisting of three and two species respectively. *Asclepias diploglossa*, *A. flava*, *A. cognata* and *A. reenensis* are transferred to Aspidonepsis, and A. **shebae** is newly described. All species are discussed, illustrated and a key is given to aid in their identification.

UITTREKSEL

Aspidonepsis, 'n genus endemies in suidelike Afrika, word beskryf en met die naverwante genus *Aspidoglossum* vergelyk. Die nuut beskrewe genus bestaan uit twee subgenusse Aspidonepsis en Unguilobium, met drie en twee spesies onderskeidelik. *Asclepias diploglossa*, *A. flava*, *A. cognata* en *A. reenensis* word na Aspidonepsis oorgeplaas, terwyl A. **shebae** nuut beskryf word. Al die spesies word bespreek, geïllustreer en 'n sleutel om te help met hul identifikasie, word gegee.

INTRODUCTION

A.A. Bullock's work on the family Asclepiadaceae (1952 to 1967) has received wide acceptance in Africa north of the Limpopo River. In southern Africa, however, his generic concepts and names have seldom been applied. This is explained partly by the fact that his research seldom included southern African plants and partly by the rejection of his work by Dyer (1975).

Unfortunately, three elements detract from Bullock's work: 1, he admitted that his delimitation of genera was only tentative (1952); 2, when resurrecting or expanding existing genera he seldom gave new descriptions for these taxa. As a result, the generic circumscriptions and exact application of some of these names is still unclear; 3, his species concepts were often very broad and there is now growing consensus that some species will need to be re-split.

Most southern African herbaria therefore still follow N.E. Brown's treatment of the Asclepiadaceae as outlined in the *Flora capensis* (1907–1909). However, workers like N.E. Brown had followed the tradition of their time and separated genera using floral differences only. They even separated some genera on the basis of a single character. Phenomena like convergent evolution were seldom taken into account, and workers were unaware that the evolution of analogous floral morphologies had taken place within the family. Bullock (1952) was the first to realize that such convergent evolution had taken place and that many genera in the family not only contained a number of unrelated entities, but that these entities could only be identified in terms of consistently produced correlated character combinations. He was the first taxonomist to attempt a phylogenetically based classification for the African members of the tribe Asclepiadeae.

What Bullock has done at the generic level, N.E. Brown has accomplished at the specific level. Consequently the work of N.E. Brown (species delimitation) and Bullock (generic delimitation) should be seen as complimentary rather than antagonistic.

Recent investigations concerning the southern African members of the genus *Asclepias sensu* N.E. Brown have shown that Bullock's generic concepts should be redefined and extended to embrace the taxa of this subcontinent (Nicholas 1981). Bearing in mind that the type species of the genus *Asclepias* L. is *A. syriaca* L., the authors agree with Bullock in the exclusion of *Asclepias* from Africa except as an adventive. The process of moving the southern African taxa of *Asclepias sensu* N.E. Brown to their correct generic position has already begun (Nicholas & Goyder 1990). The authors understand the desirability of giving a brief generic synopsis of the subtribe Asclepiadinae in Africa at this early stage of their work. However, as a number of genera still need to be: 1, resurrected from synonomy; 2, newly described; 3, extensively redefined; they feel that it is at present unwise to publish information that may change as their research progresses.

Aspidonepsis diploglossa (Turcz.) A. Nicholas & D.J. Goyder, *A. flava* (N.E. Br.) A. Nicholas & D.J. Goyder, *A. cognata* (N.E. Br.) A. Nicholas & D.J. Goyder, *A. reenensis* (N.E. Br.) A. Nicholas & D.J. Goyder and *A. shebae* A. Nicholas & D.J. Goyder form a phylogenetic unit quite distinct from the rest of *Asclepias sensu* N.E. Brown and can be distinguished from other genera in the tribe Asclepiadeae by the following set of consistently present correlated characteristics:

1. a globose, fusiform or napiform tuber just below the soil surface;
2. a single erect stem (rarely up to 3 in *A. flava*);
3. spreading to ascending linear to narrowly elliptic leaves which are ranked up the stem;
4. inflorescences gathered together at the top of the flowering stem, even if nodally produced;

* National Botanical Institute, Private Bag X101, Pretoria 0001. Formerly: South African Liaison Botanist, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, England, UK.

** The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, England, UK.

MS. received: 1990-10-24.

5, persistent inflorescence bracts, often grading with the leaf system;

6, cucullate corona lobes which are produced 0.5 to 1.8 mm above the insertion of the corolla;

7, a saccate corona lobe cavity;

8, wishbone-shaped pollinaria, with semicircular to hemiovoid pollinia.

Aspidonepsis is confined to high altitude grasslands of the Drakensberg and its foothills, although outlying populations of some species may be found in mountainous situations as far south as Grahamstown and on montane 'islands' nearer the Transkei-Natal coast. The northern limit of distribution of this endemic southern African genus is the eastern Transvaal. Species are usually, but not always, found in situations subject to annual burning. Populations are intermittent in the wild and usually consist of few widely dispersed individuals. Occasionally up to three tubers are produced in a connected series, possibly representing subsequent year's growths.

Aspidonepsis bears a number of similarities to the genus *Aspidoglossum* (Table 1), and it is the authors' opinion that the two genera may have originated from the same distant, ancestral stock. However, if this is the case, then the two taxa have since evolved along very different lines, for a number of major disjunctions in morphology now exist, such as the aggregation of inflorescences near the stem apex and the central cavities in the corona lobes of *Aspidonepsis*. In contrast *Aspidoglossum* bears inflorescences that are produced along the length of the stem and there is no corona lobe cavity.

The affinity of these two genera can be clearly seen in the corona lobe and pollinarium morphology of *Aspidoglossum delagoense* (Schltr.) Kupicha, which is very similar to *Aspidonepsis* (Figure 1). However, all other features of this species place it clearly within *Aspidoglossum*, of which *A. biflorum* E. Mey. is not only the type species but also typical of the genus as a whole (Kupicha 1984). *Aspidoglossum* has more species and is morphologically more diverse than *Aspidonepsis*.

The five species recognized in *Aspidonepsis* fall into two well-defined groups that require recognition at subgeneric level. The first group is characterised by spreading or ascending corolla lobes and cup- or dish-shaped corona lobes with a tooth-like appendage projecting from the floor of the corona lobe cavity. The second group has reflexed corolla lobes and corona lobes with a more angled outer margin and no tooth-like structure projecting from the floor of the corona lobe cavity.

A total of 187 pressed specimens were examined during the course of this study from the following herbaria: BOL, CPF, GRA, J, K, NBG, NH, NU, PRE, SAM and TCD*. Additional data were obtained from spirit collections and supplemented by observations in the field.

* Herbarium abbreviations are taken from Holmgren *et al.* (1990).

TAXONOMY

Aspidonepsis *A. Nicholas & D.J. Goyder*, gen. nov., *Aspidoglosso* affinis sed sinu coronae lobis prominenti et appendice distali coronae lobis non filiformi nec ornata differt.

Herba perennis. *Caudex*: tuber globosum, fusiforme vel napiforme. *Caulis* unicus (raro duo vel tres), erectus, gracilis, usque 625 mm tantum longus. *Folia* expansa, anguste elliptica vel linearia in subgenere *Aspidonepse*, sed ascendentia, linearia vel nonnunquam lanceolata, margine manifeste revoluta in subgenere *Unguilobio*. *Inflorescentia* umbellata, terminalis subterminalisve vel ad nodos disposita, 2–17-flora (in subgenere *Aspidonepse*), 4–11-flora (in subgenere *Unguilobio*); bracteae ad anthesin persistentes. *Coronae lobi* partibus inferioribus ad columnam staminalem connatis; 0.5–1.8 mm supra corollam producti, cucullati; sinus profundus appendice linguiformi centrali ornatus in subgenere *Aspidonepse*. Appendix proximalis ad apicem deltato-falcata et apicem stylii aequans vel superans impendensque; extremum distale coronae appendice parva ornatum vel appendice carente; sinus profundus rimiformis in subgenere *Unguilobio*. *Appendix antherae* reniformis vel pescapriformis profunde apicaliter fissa.

TYPUS.—*Aspidonepsis diploglossa* (Turcz.) A. Nicholas & D.J. Goyder, *vide infra*.

Perennial geophytic herb. *Rootstock* a globose, fusiform or napiform tuber. *Stems* 1 (rarely as many as three in *A. flava* only), erect, never more than 630 mm tall. *Leaves* spreading to ascending, linear, lanceolate to narrowly elliptic, older leaves shorter and broader; petiole

TABLE 1.—A comparison of *Aspidonepsis* and *Aspidoglossum*.

Character	*Aspidonepsis*	*Aspidoglossum*
Habitat	Montane only	Widespread
* Habit in the field	Erect	Erect but usually pendulous apically
Stem number	1, up to 3 in *A. flava*	Usually 1 to a few, occasionally many
Leaf insertion	Opposite	Opposite, or occasionally verticillate or irregular
Leaf shape	Usually linear, rarely lanceolate	Usually linear, rarely suborbicular, elliptic or obovate
* Inflorescence production	Near the stem apex only	Along the length of the stem, but also gathered apically
Inflorescence insertion	Not fascicled, rarely sessile	Fascicled, almost sessile near stem apex
* Flower colour	Yellow, purple, and brown	Purple and green, never yellow
* Corona lobe ornamentation	Appendages never complicate or filiform	Appendages either complicate & filiform or not ornamented
* Corona lobe cavity	Present	Not present, or rarely rudimentary
* Central corona lobe appendage	Within the corona lobe cavity	Present but not in the corona lobe cavity
Pollinaria shape	Wishbone-shaped	Wishbone-shaped or pachyform
Pollinia shape	Sausage-shaped	Sausage-shaped to pyriform

* important differences between the two taxa.

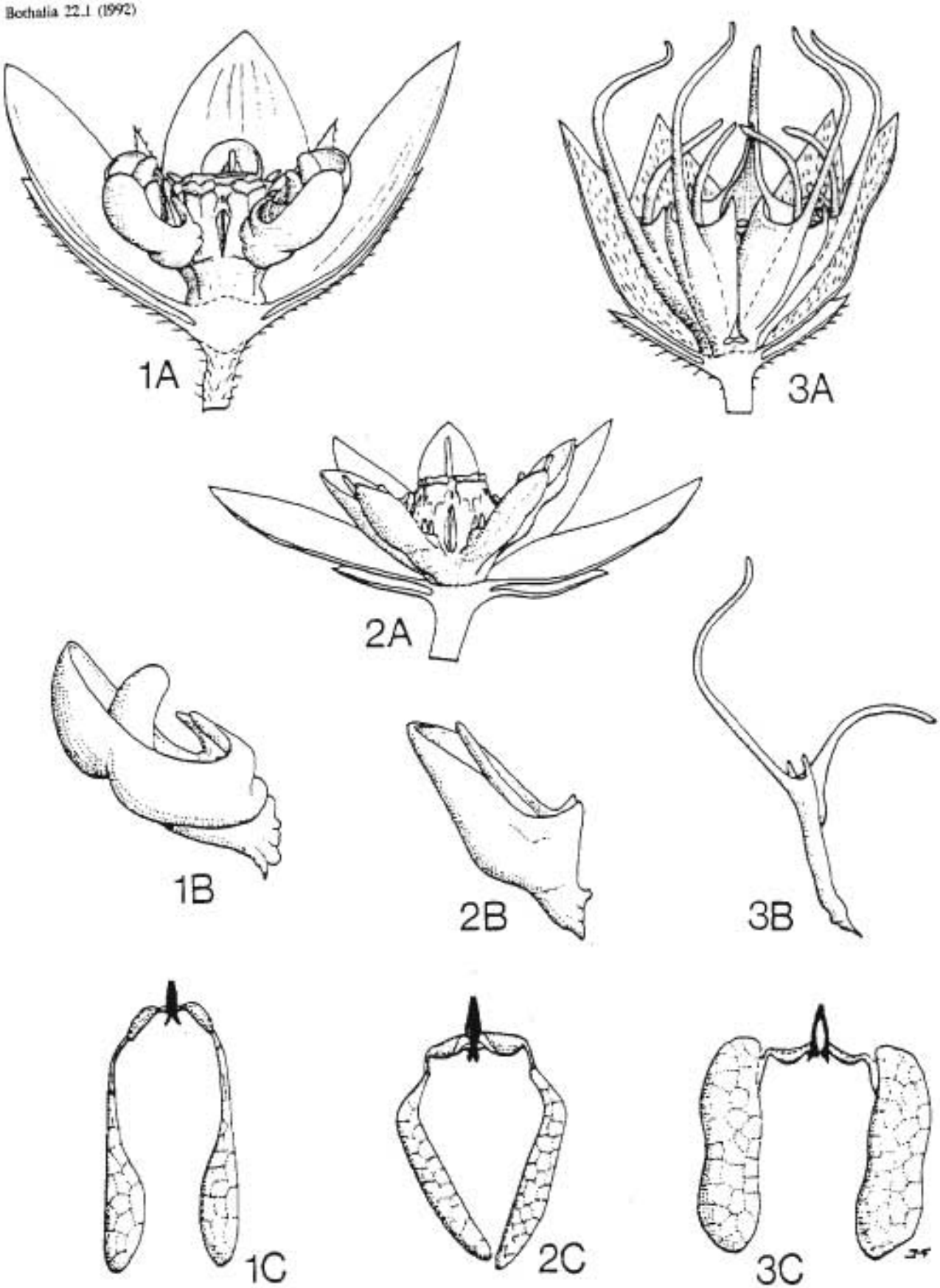

FIGURE 1 .—Comparison of 1, *Aspidonepsis flava*, *Coleman 813*, (PRE); 2, *Aspidoglossum delagoense*, *Barbosa & De Lemos 7958*, (K); 3, *Aspidoglossum biflorum*, *Bolus 238*, (K). A, flower with part of corolla removed: 1A, × 11; 2A, × 9.5; 3A, × 7. B, corona lobe, side view: 1B, × 28; 2B, × 15; 3B, × 11. C, pollinarium: 1C, × 48; 2C, × 22; 3C, × 55.

0–5 mm long. *Inflorescences* umbelliform; terminal, subterminal and nodal; bracts present at anthesis. *Corolla* catilliform or reflexed with lobe apices ascending. *Corona* with lower parts fused to the staminal column; lobes produced 0.5–1.8 mm above the corolla, cucullate; cavity saccate with appendage (subgenus *Aspidonepsis*) or without appendage (subgenus *Unguilobium*). *Anther appendages* reniform to pescapriform, with a deep apical cleft, or rectangular. *Style*: head swollen; apex truncated. *Pollinaria* wishbone-shaped; corpusculum fusiform;

translator apparatus articulated and winged; pollinia semicircular to heniovoid or clavate. *Habitat*: high altitude mountain grasslands. *Distribution*: southern African Drakensberg. *Erymology*: *Aspidonepsis* = *Aspidoglossum's* cousin. *Aspid(os)*, (Greek for shield) but used here to indicate the genus *Aspidoglossum*, and *anepsia* (Greek for cousin).

Key to subgenera and species

1a Corolla not fully reflexed when mature. Corona lobe cavity with a tongue-like appendage (Subgenus *Aspidonepsis*:
2a Proximal corona lobe appendages projecting over the style apex ..... *A. cognata*
2b Proximal corona lobe appendages not projecting over the style apex:
3a Corona lobes with arm-like proximal appendages that cross over each other and reflex back into the coronal cavity. These appendages are below the style apex and level with the anther wings ..... *A. flava*
3b Corona lobes without true proximal appendages, instead, the proximal ends are produced into dentate or obtuse (but not protruding) shoulders that are level with the style apex ..... *A. diploglossa*
1b Corolla reflexed when mature. Corona lobe cavity without an appendage (Subgenus *Unguilobium*):
4a Distal corona lobe appendage present (if somewhat short). Transkei, Natal and southern Transvaal bordering Natal ..... *A. reenensis*
4b Distal corona lobe appendage absent. Eastern Transvaal only ..... *A. thebae*

ENUMERATION OF THE SUBGENERA AND SPECIES

A. Subgenus **Aspidonepsis**

Inflorescences 2–17-flowered. *Flowers* yellow, green, brown and purple or these in combination. *Corolla* catilliform with lobe apices curving upwards or spreading, lobes with abaxial surface glabrous. *Corona lobes*: upper proximal margin various, distal margin obtusely rounded or truncate and raised above the proximal appendages (except *A. diploglossa*); cavity saccate with a centrally produced laterally flattened tongue-shaped or botuliform appendage. *Anther appendages* reniform or pescapriform with a deep apical cleft. *Pollinia* narrowing proximally; translator arms in two distinct parts, winged (Table 2).

This subgenus is composed of three species: *Aspidonepsis diploglossa*, *A. flava* and *A. cognata*. For a number of years these three species were considered conspecific, and lumped together under the oldest name, viz. *A. diploglossa*. However, although all three species are vegetatively similar, close examination shows that they are distinct entities with very different floral morphologies (Nicholas 1987). They are usually found in annually burnt or grazed, high to medium altitude, montane grasslands. They are found along the Natal-Transkei Drakensberg, and on scattered island mountain ranges in the eastern Cape and Natal midlands. The flowers of this subgenus are predominantly yellow or yellow-green, although occasionally flowers with brown or purple markings can be found.

1. **Aspidonepsis diploglossa** *(Turcz.) A. Nicholas & D.J. Goyder*, comb. nov. Type: South Africa, Cape Province, peaks of the Winterberg, *Ecklon 23* (KW holo., photo!; PRE!, iso.).

Gomphocarpus diploglossus Turcz.: 258 (1848). *Asclepias diplogiossa* (Turcz.) Druce: 605 (1917).

Asclepias schizoglossoides Schltr.: 32 (1894); Schltr.: 451 (1896); N.E. Br.: 688 (1908); Wood: 461 (1910); Phillips: 194 (1917). Type: South Africa, eastern Cape, *Mrs Barber s.n.* (K!, neo., here designated).

Rootstock 1 or several tubers connected in series, 9–35 × 6–12 mm. *Stems* 1, erect, 170–400(–500) mm tall, bifariously pubescent. *Leaves* ascending to spreading, narrowly lanceolate, occasionally falcate, rarely linear or narrowly elliptic, 5–84(–130) × (0.25–)0.5–7.0 mm; apex acuminate or occasionally acute; base petiolate to cuneate; apetiolate or petiole up to 4 mm long. *Inflorescences* 1–3 per plant, 4–16-flowered, bracts present at anthesis; peduncles up to 9.5 mm long or occasionally inflorescences apedunculate. *Flowers* 4–9 × 6–13 mm, yellow

TABLE 2.—A comparison of the two subgenera *Aspidonepsis* and *Unguilobium*. All measurements in mm

Character	*Aspidonepsis*	*Unguilobium*
Stem length	170–550	190–625
Leaf length	5–133	7–56
Peduncle length	0–175	5–90
Flower colour	Yellow, green, purple & brown	Yellow, purple & brown
* Corolla orientation	Spreading erect	Reflexed
Petal length	3.5–10.5	5.2–6.5
* Corona lobe shape	Cup-like (cucullate)	Claw-like (unguiform)
Proximal corona lobe appendage length	None–1.2	0.4–1.3
Distal corona lobe appendage length	None	None–0.5
* Corona lobe cavity appendage length	0.2–1.3	None
Alar fissure length	0.5–1.4	0.7–1.1
Anther appendage length	0.3–0.6	0.5–1.5
Style apex diameter	1.1–2.8	1.6–2.4
Translator arm length	0.18–0.56	0.28–0.64
Corpusculum length	0.16–0.32	0.2–0.4
Pollinium length	0.48–0.96	0.68–1.0

* characters forming discontinuities between the two taxa.

or yellow-brown; pedicel 6–16 mm long. *Calyx*: lobes lanceolate, occasionally triangular or narrowly ovate, 2.5–4.6 × 1.0–1.5 mm, apex acuminate, pubescent to tomentose. *Corolla*: lobes ovate or occasionally elliptic, free to the base, 4–6(–7) × 2.4–4.1 mm; inside yellow, occasionally tinted with purple or lilac, outside yellow, brown or purple, these often in combination; abaxial surface with a few sericeous hairs. *Corona lobes* produced ± 0.5 mm above corolla, cucullate-cyathiform, 4–6(–7) × 2.4–4.1 mm, upper proximal ends forming 2 rounded shoulders, occasionally extended into short pointed appendages, level with or projecting (slightly) onto style apex, distal end obtuse or rounded without a distinct appendage and level with or lower than style apex, saccate cavity with a tongue-like or deltoid-oblong appendage 0.2–0.8 mm wide, projecting 0.2–0.7 mm above upper lobe margin, colour yellow to bright yellow. *Staminal column* 2.0–2.8 mm long; anther wings shallowly concave in upper two thirds, rounded at base, 0.75–1.1 × 0.3–0.5 mm; anther appendages pescapriform or ovate with a deep apical cleft, membranous, 0.3–0.6 × 0.6–0.9 mm, decumbent on style apex. *Style apex* truncated, with thickened undulating margins, concave in centre, 1.1–2.1 mm diameter, bright green to white. *Pollinaria*: corpusculum (0.22–)0.28–0.32 × 0.08–0.16 mm; translator arms 0.2–0.32(–0.36) mm long, thin with small transparent hook-like wings, pollinia clavate, 0.68–0.80(–0.84) × 0.24–0.36 mm. *Fruits* and *seeds* not seen. *Specific epithet etymology*: from the Greek words diplo- (two) and glosso- (tongue); probably in reference to the corona lobe and the appendage in its central cavity. (Figure 2.1).

Aspidonepsis diploglossa is found in annually burnt montane grasslands, normally on south- or east-facing hillside slopes or mountain plateaux. Usually, but not always, occurring in wettish areas. Collectors often report it as rare, although a great many collections exist. It is usually found growing at altitudes ranging from 1 500 to 2 400 m, but occasionally also at lower altitudes. Plants flower from October to January. The tubers of this plant lie just below the soil surface, and when sectioned reveal white, woody flesh that oozes sticky, milky latex.

A. diploglossa, a mountain-loving species, exhibits a rather strange distribution. It may be found at high altitudes around Grahamstown and Hogsback in the eastern Cape, then there is a gap in the Transkei Drakensberg (which may be an artifact caused by poor collection in this area) and then it occurs abundantly along the Natal Drakensberg and its foothills as far as Van Reenen's Pass. After yet another gap it is found again in the Wakkerstroom area. *A. diploglossa* may also inhabit mountain islands in the Natal midlands at places such as Inanda, Greytown and Weenen. However, it occurs in the most unlikely place near the southern Natal coast at the Umtamvuna Nature Reserve, where it grows at an altitude of only 350 m. This nature reserve is well known scientifically because it lies within the narrow belt of Natal Group sandstone in the coastal region between Port Shepstone and Port St Johns. Its rich flora includes a number of rare plants and endemic species. However, the occurrence of *Aspidonepsis diploglossa* at such a low altitude and so near the sea, is surprising and inexplicable (Figure 3).

Unfortunately, when R. Schlechter described *Asclepias schizoglossoides* in 1894 he not only failed to cite the specimens he examined, but was also unaware that he was dealing with an already described taxon. Turczaninow had named this species *Gomphocarpus diploglossus* in 1848, citing *Ecklon 23* as the type. N.E. Brown picked up these two errors when preparing the Asclepiadaceae for *Flora capensis*, and in correspondence with Schlechter discovered that the latter taxonomist had based the name *Asclepias schizoglossoides* on a Barber specimen 'probably collected in British Kaffraria'. As a result, N.E. Brown (1908) suspected that the specimen may be part of Mrs Barber's gathering numbered 35. N.E. Brown's selection of *Barber 35* as the type of the name *Asclepias schizoglossoides* for *Flora capensis* was probably correct. However, due to the destruction of Schlechter's asclepiadaceous collections housed at Berlin herbarium during the Second World War, we cannot confirm this. In this paper we have, therefore, chosen *Barber 35* (K) as the neotype of the name *Asclepias schizoglossoides*.

W.H. Harvey has written (in pencil) on two Trinity College Dublin herbarium (TCD) sheets of this species, the name *Gomphocarpus luteus* (var.) *β heterophyllus*. This name was never validly published, and must be considered nothing more than a manuscript name.

Aspidonepsis diploglossa differs from *A. flava* and *A. cognata* in possessing longer (occasionally narrower) leaves, a deeply cleft anther appendage, yellow to yellow-brown flowers and a simple cup-shaped corona lobe, the upper proximal ends of which are no more than blunt rounded shoulders level with the style apex. See Table 3.

NATAL.—2730 (Vryheid): Altemooi, (–AD), *Thode All73* (NH, PRE). 2731 (Louwsburg): near Ngome, (–CD), *Schrire 1027* (NH). 2828 (Bethlehem): Royal Natal National Park, (–DB), *Trauseld 122* (PRE); Mont Aux Sources, (–DD), *Schweickerdt 779* (PRE). 2829 (Harrismith): Van Reenen, (–AD), *Jacobsz 1656* (PRE); Klawervlei, (–CA), *Blom 287* (PRE); Cathedral Peak State Forest, (–CC), *Killick 1086* (CPF, PRE). 2830 (Dundee): Weenen, (–CC), *Rogers 28436* (K). 2929 (Underberg): Giant's Castle, (–AB), *Stewart 2070* (K, NU); Tabamhlope Mountain, (–BA), *West 1383* (NH, PRE); Highmoor State Forest, (–BC), *Killick & Vahrmeijer 3583* (K, NH, PRE); Restmount area, (–CB), *Hilliard & Burtt 15557* (K); Bushman's Nek area, (–CC), *Hilliard & Burtt 17436* (K, PRE); Garden Castle Nature Reserve, (–CD), *Hilliard & Burtt 7866* (K, NU); Rumyneade, (–DB), *Moll 1480* (NU); near Maiwaga, (–DC), *Rennie 235* (NU); Glengariff, (–DD), *Rennie 488* (NU). 2930 (Pietermaritzburg): near Pietermaritzburg, (–AC), *Ram s.n.* (NU); Cavenham, (–AD), *Mogg 2477* (PRE); Greytown, (–BA), *Wylie s.n.* (K, NH 21644, PRE ex Transvaal Museum 34205); Durgie, (–CA), *Rennie 39* (K, TCD); near Richmond, (–CD), *Wood 10819* (NH); Inanda, (–DB), *Groom s.n.* (K ex Wood 1408, NH 4106).

TRANSKEI.—3028 (Matatiele): near Ramaneliso, (–BB), *Boardman All* (PRE). 3029 (Kokstad): Ensikeni, (–BA), *Haygarth s.n.* (NH ex Wood 12049). 3130 (Port Edward): Umtamvuna Nature Reserve, (–AA), *Abbott 2868* (NH).

CAPE.—3227 (Sutterheim): near Fort Cunynghame, (–AD), *Sim s.n.* (BOL); Hogsback, (–CA), *Rattray s.n.* (BOL 15767); Dohne Hill, (–CB), *Sim 1237* (BOL, NU, PRE, SAM). 3326 (Grahamstown): Coldspring, (–AD), *Glass 276* (K, PRE, SAM); Howison's Poort, (–AD), *Hutton s.n.* (TCD); Grahamstown, (–BC), *MacOwan 850* (K).

WITHOUT PRECISE LOCALITY.—Eastern Cape, *Barber 35, s.n.* (K); Cape. (Mrs Barber records it as being collected at the Winterberg, but its occurrence there is highly improbable. Possibly she meant the Winterhoek Mountains near Uitenhage or the Klein Winterhoek near the Zuurberg, where its occurrence is much more likely) *Barber 84* (K, TCD).

2. **Aspidonepsis flava** *(N.E. Br.) A. Nicholas & D.J. Goyder*, comb. nov. Type: Transkei, Malowe Mountain, *Tyson 1086* (K! lecto., here designated; BOL!, SAM!, isolecto.)

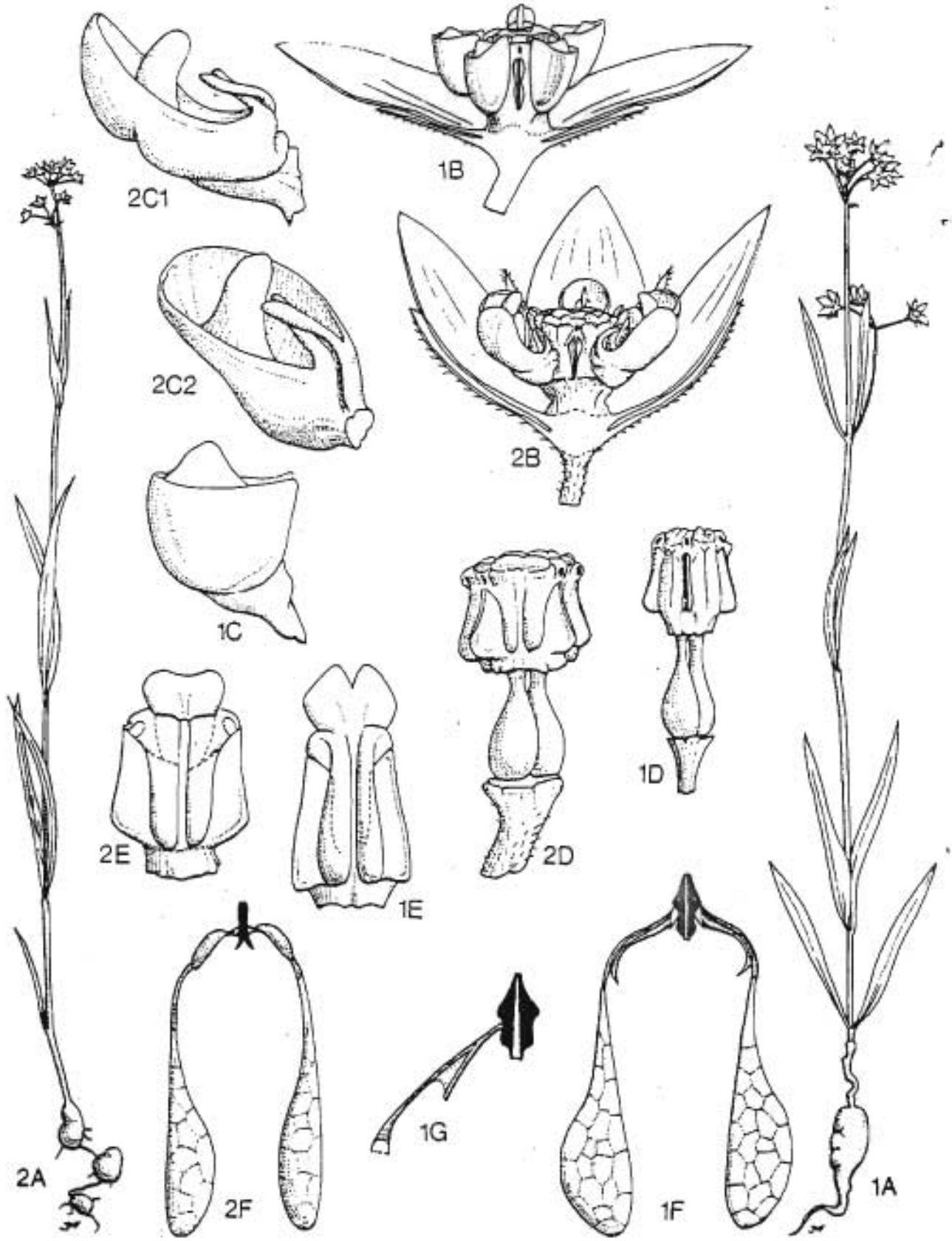

FIGURE 2.—1. *Aspidonepsis diploglossa*: 2. *A. flava*. A, whole plant with flowers: 1A, × 0.7; 2A, × 0.4. B, flower with part of corolla removed: 1B, × 10; 2B, × 9. C, corona lobe: 1C & 2C1, side view, × 14 & × 27; 2C2, angled view to show crossed, inwardly flexed proximal appendages, × 30. D, gynostegium excluding corona: 1D, × 16; 2D, × 19. E, abaxial surface of anther: 1E, × 24; 2E, × 30. F, pollinarium: 1F, × 51; 2F, × 65. 1G, translator apparatus showing winged spur, × 89. 1A, *Ruddock 136* (CPF); 1B, 1D, 1E, 1F, *Boardman All* (PRE); 1C, 1G, *Boardman 186* (PRE); 2A–2C1, 2D–2F, *Coleman 813* (PRE); 2C2, *Wood 4249* (NH).

TABLE 3.—A comparison of the three species of subgenus *Aspidonepsis*. All measurements in mm

Character	*A. diploglossa*	*A. flava*	*A. cognata*
Leaf length	5–33	7–83	7–68
Petiole length	0–4	0–5	0–3
Peduncle length	0–95	4–175	3–92
Flower colour	Yellow purple	Yellow, yellow & brown	Yellow-green
‡ Petal length	4–7	3.5–5.0	5.8–10.5
* Corona lobe shape	Bonnet-like	Cup-like	Bowl-like
* Coronal lobe cavity depth	1.1–2.0	0.4–0.7	2.2–2.5
# Proximal corona lobe appendage length	None	0.25–0.7	0.6–1.2
+ Corona lobe cavity appendage length	0.2–0.7	0.4–0.7	0.8–1.3
• Alar fissure length	0.75–1.1	0.5–0.7	0.8–1.4
‡ Anther appendage length	0.6–0.9	0.5–0.8	0.8–1.3
Style apex diameter	1.1–2.1	1.1–1.6	1.5–2.8
• Pollinium length	0.68–0.84	0.48–0.68	0.72–0.96
• Pollinium width	0.24–0.36	0.16–0.24	0.24–0.32

Discontinuities between *A. diploglossa* and the other two taxa; • discontinuities between *A. flava* and the other two taxa; + discontinuities between *A. cognata* and the other two taxa; ‡ discontinuities between *A. flava* and *A. cognata*; * discontinuities between all three taxa.

Rootstock a globose tuber, occasionally several connected in series, 6–10 × 4–9 mm. *Stems* usually 1, rarely as many as 3, slender, erect, 180–475 mm long. *Leaves* spreading to erect, lanceolate, linear to narrow-elliptic, 7–83 × 0.5–6.0(–7.0) mm; apex acuminate or rarely acute; base petiolate to cuneate. *Inflorescences* 1–3(–6) per plant, 1–3 per stem, 4–18(–24)-flowered; bracts present at anthesis, 2.6–5.3(–7.5) × 0.15–0.5 mm; peduncles (4–)10–175 mm long. *Flowers* 3–5(–6) × 5–8 mm; pedicel 5–11 mm long. *Calyx*: lobes lanceolate, 2.0–3.6(–4.0) × 0.7–1.2 mm. *Corolla*: lobes ovate, occasionally elliptic, free to the base, 3.5–5.0 × 2.0–3.2 mm, inside greenish yellow or yellow, outside yellowish green, pale yellow or yellow with a purple apex, margins occasionally slightly revolute. *Corona lobes* produced 0.5–0.8 mm above corolla, cucullate-crateriform, in side view boxing glove-shaped, 1.0–1.6 mm long, upper proximal ends extending into 2 short (0.25–0.70 mm), subulate or arm-like appendages that meet and are then reflexed back to point to distal end of lobe, lower than style apex, distal end dilated and bowl-shaped with upper margin overtopping the style apex (even if only slightly); cavity crateriform, 0.4–0.7 mm deep with a central sausage-shaped appendage projecting 0.4–0.7 mm above cavity margin; orange-yellow, golden yellow, yellow-green or yellow. *Staminal column* 1.0–1.5 mm long; anther wings shallowly concave in upper two thirds, rounded in lower third, truncate basally, 0.5–0.7 × 0.2–0.45 mm; anther appendages reniform, membranous, (0.2–)0.3–0.4 (–0.5) × 0.5–0.8 mm, decumbent on sides and top of style apex. *Style apex* truncate, margin undulate, apex concave with a small central pore, 1.1–1.6 mm wide. *Pollinaria*: corpusculum 0.16–0.20(–0.26) × (0.60–)0.08–0.10 mm; translator arms (0.20–)0.18–0.28 mm long; pollinia dilated distally, narrowing proximally, (0.48–)0.52–0.64 (–0.68) × 0.16–0.24 mm. *Fruits*: mature follicles not seen, immature follicles narrowly fusiform with an attenuate apex, not echinate. *Seeds* not seen. *Specific epithet etymology*: from the Latin word *flav(us)* meaning pale yellow. This is in reference to the pale yellow flowers of this species. (Figure 2.2).

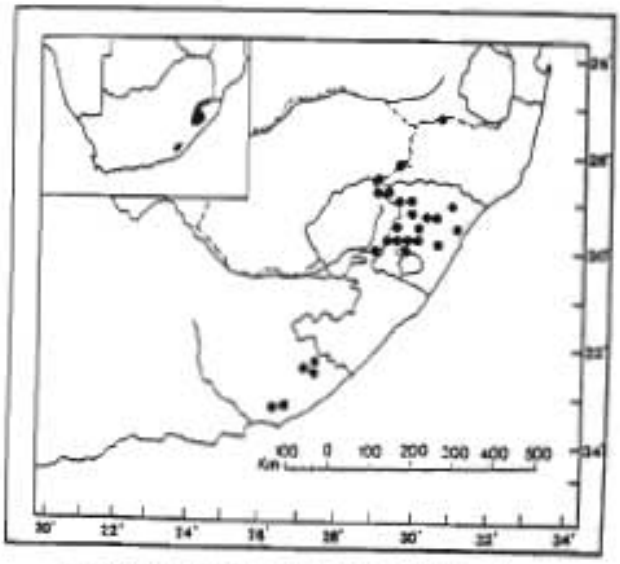

FIGURE 3.—Distribution of *Aspidonepsis diploglossa*.

Aspidonepsis flava is usually found growing in annually burnt montane grasslands. Colonies are usually scattered and occur at altitudes between 600 and 2 000 m, rarely at altitudes as low as 450 m. Distributed from Grahamstown in the eastern Cape through Transkei to Natal. This species is commonly found in the Drakensberg or its foothills, although it can be found in the midland and coastal belts if mountainous areas provide it with a suitable refuge (Figure 4). *A. flava* flowers in the midsummer months between November and January, although there is one record of a plant flowering in October.

This taxon was first described by N.E. Brown in *Flora capensis* (1908), and is abundant in southern Natal and the Transkei interior. The limits of its southern distribution is near Grahamstown where a few specimens have been collected. Plants grow in small colonies in annually burnt grasslands, and usually occur on hillside slopes amongst scattered rocks where they receive some protection from grazing animals and fire. Plants may have up to three tubers connected in series, each probably representing a previous year's growth. Like *A. diploglossa*

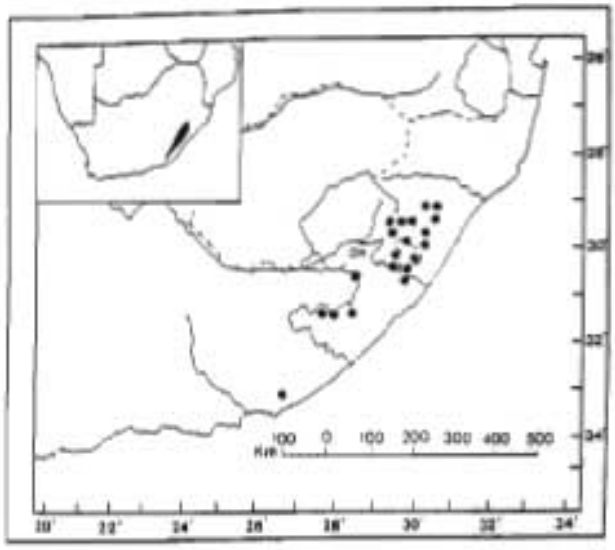

FIGURE 4.—Distribution of *Aspidonepsis flava*.

these globose tubers are found just below the soil surface, and have white, latex-filled flesh.

A. flava is distinguished from the other two species in subgenus *Aspidonepsis* by its longer peduncles, smaller, paler coloured flowers, smaller pollinaria, bowl-shaped corona lobes with arm-like proximal appendages that cross one another and are then reflexed into the corona lobe cavity and the sausage-shaped appendage projecting from the floor of the corona lobe cavity. Table 3.

NATAL.—2929 (Underberg): Cobham State Forest, (−CB), *Cowan 124* (NU); near Underberg, (−CD), *Dyer 3764* (K, NH); Mawahqua Mtn area, (−DA), *Rennie 275* (NU); Mpendle, (−DB), *Huntley 625* (NH); Nkonzo State Forest, (−DD), *Nicholas & Norris 1159* (CPF, NH, PRE). 2930 (Pietermaritzburg): Howick, (−AC), *Huston 408* (BM, K, PRE); Benvie, Karkloof, (−AD), *Hilliard & Burtt 13491* (NU); Winterskloof, (−CB), *Sim s.n.* (PRE); near Byrne Village, (−CC), *Sanwari 2023* (K, NU); Weza State Forest, (−DA), *Nicholas 2080* (NH); Fort Donald, (−DC), *Tyson 1660* (SAM). 3030 (Port Shepstone): Izopo, (−AA), *Shirley s.n.* (NU).

TRANSKEI.—3028 (Matatiele): near Elland's Height, (−CD), *Sanwari 1908* (NU). 3029 (Kokstad): near Mt Currie, (−AD), *Hutchinson 1823* (K), *Tyson 1686* (BOL, PRE, SAM); Ensikeni, (−BA), *Haygarth s.n. ex Wood 12049* (NH 18644, SAM); Malowe, (−BD), *Tyson 2723* (K, SAM); Vaal Bank, (−CB), *Haygarth s.n. ex Wood 4230* (K, NH). 3127 (Lady Frere): Mount Kwenkwe, (−DA), *Bolus 10225* (BOL), Engcobo, (−DB), *Bolus 10226* (BOL). 3128 (Umtata): Mhlahlane, (−BC), *Hutchings 1387* (KEI); Bazija, (−CB), *Baur 556* (K, SAM).

CAPE.—3326 (Grahamstown): Grahamstown, (−BC), *Glass 1503* (K, NBG).

WITHOUT PRECISE LOCALITY.—Natal (Liddesdale), *Wood 4249* (K, NH); *Gerrard 1315* (BM, K).

3. **Aspidonepsis cognata** *(N.E. Br.) A. Nicholas & D.J. Goyder*, comb. nov. Type: Transkei, Mount Insizwa, *Schlechter 6496* (K!, holo.; BOL!, NH!, PRE!, iso.)

Asclepias cognata N.E. Br.: 687 (1908).

Rootstock a tuber, ± 7×7 mm. *Stems* 1, erect, 180–550 mm tall. *Leaves* spreading to ascending, linear, occasionally lanceolate, (7–)11–68 × (0.3–)0.7–4.0(–6.0) mm; apex acuminate, base shortly petiolate, occasionally cuneate. *Inflorescences* occasionally subtended by leaves, 1–2 per plant, 1–7(–9)-flowered; bracts not fugaceous, grading with leaves; peduncles 3–76(–92) mm long. *Flowers* 5–12 × 7–17 mm; pedicels 6–12 mm long. *Calyx*: lobes lanceolate, 3.0–5.0 × 1.0–1.8 mm, apex acuminate. *Corolla* glabrous; lobes elliptic, occasionally narrow-elliptic to ovate, (5.8–)7.6–10.5 × 2.6–5.8 mm, apex acute, inside yellow, yellow-purple, brown-purple, yellow and lilac, outside pale greenish yellow sometimes suffused purple, or mustard yellow, or greenish brown, or base yellow and apex purple, or base mauve and apex yellow to dark brown, or yellow-brown with purple veins. *Corona lobes* produced 1.5–1.8 mm above corolla, cucullate, bonnet-shaped, 3.0–4.8(–5.3) [oblique measurement] × 1.3–2.5 mm, upper proximal ends extended into 2 short (0.6–)0.8–1.2 mm, subulate or arm-like appendages sometimes projecting over style apex, dilated distal end overtopping style apex by 0.6–1.0 mm and truncated along its upper margin; cavity 0.8–1.3 mm deep with a yellow tongue-like central appendage projecting 0.8–1.3 mm above lip of corona lobe (i.e. almost level with the upper margin of the distal end); colour dull yellow-green, mustard yellow, or yellow and purple, with red or brown along the margin. *Staminal column* 1.5–2.6 mm long; anther wings 0.8–1.4 × 0.4–0.6 mm; anther appendages reniform, membranous, 0.3–0.6 × 0.8–1.3 mm, decumbent on the sides of the style head. *Style apex* truncated with thickened undulate margins, concave with a small pore in the centre, 1.5–2.8 mm wide. *Pollinaria*: corpusculum 0.2–0.3 × 0.1–0.12 mm; translator arms 0.32–0.56 mm long; pollinia semi-circular to semi-ovate with a short narrow proximal end, 0.72–0.96 × 0.24–0.32 mm. *Fruits*: mature follicles not seen, young follicles tomentose (but not echinate). *Seeds* not seen. *Specific epithet etymology*: from the Latin word *cognat(us)* meaning related. Unfortunately, N.E. Brown did not explain the sense in which he applied this name. (Figure 5).

Aspidonepsis cognata may be found scattered in annually burnt (but not always) montane grassland, usually occurring in river valleys or near streams where the soil is quite damp. This graceful species flowers between November and December (although there is one record for October), and occurs at altitudes between 1 200 and 2 100 m, rarely lower. *A. cognata* is confined to a small area in the southern Natal and northern Transkei Drakensberg (Figure 6).

It is unfortunate that N.E. Brown (1908) chose *Schlechter 6469* as the type of *Asclepias cognata*, because this collection is not typical of the species as a whole. However, all specimens of *Schlechter 6469* examined, although not typical, clearly belong to this species. In appearance *Hilliard & Burtt 7855* is more representative of the species.

Aspidonepsis cognata can be distinguished from the other species in subgenus *Aspidonepsis* by its larger flowers, larger corona lobes which are broadly helmet-shaped, wider anther appendages and its longer translator arms and pollinia. (See Table 3). The corona lobe shape is highly diagnostic, in particular the subulate or arm-like proximal appendages which may project over the style apex, and the raised distal end which is usually truncated along its upper margin and overtops the style head.

NATAL.—2929 (Underberg): Fort Nottingham Commonage, (−BD), *Wright 224* (NU); Gxalingenwa Valley, (−CB), *Hilliard & Burtt 17090* (K, PRE); Garden Castle State Forest, (−CC), *Hilliard & Burtt 13767* (K, NU); Umzimkulu headwaters, (−CD), *Hilliard & Burtt 7855* (K, NU); Mpendle, (−DB), *Hilliard & Burtt 13856* (NU).

TRANSKEI.—3029 (Kokstad): Ensikeni, (−BA), *Haygarth s.n. ex Wood 12045* (K, NH 13661); Mount Insizwa, (−CD), *Schlechter 6496*

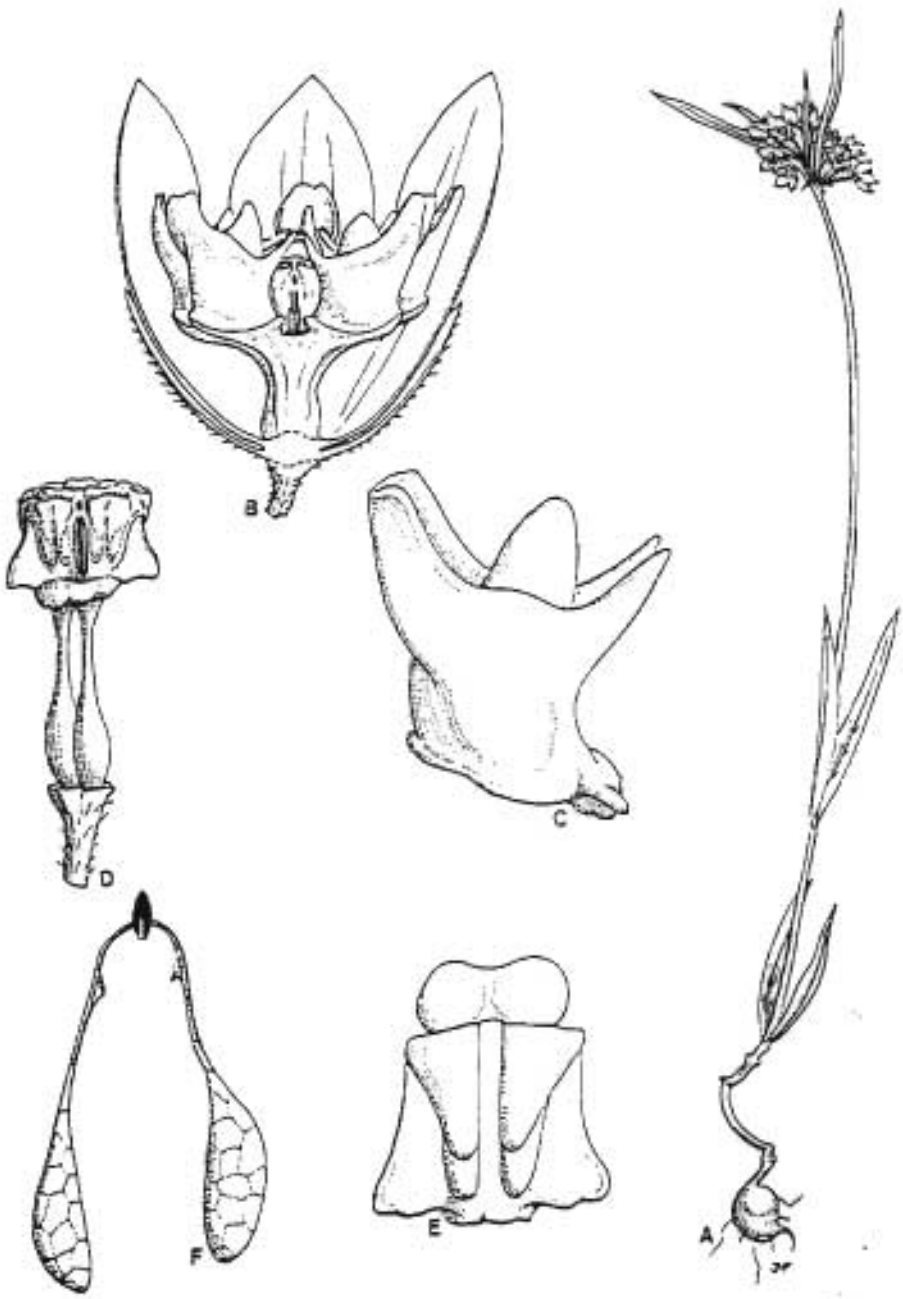

FIGURE 5.—*Aspidonepsis cognata*. A, whole plant with flowers, × 0.5; B, flower with part of corolla removed, × 4.5; C, corona lobe side view, × 11; D, gynostegium excluding corona, × 9; E, abaxial surface of anther, × 19.5; F, pollinarium, × 36. A–F, *Hilliard & Burtt 9056* (NU).

(BOL, K, NH, PRE); Weza State Forest, (–DA), *Nicholas 2081* (NH, MO).

B. Subgenus Unguilobium

Unguilobium *A. Nicholas & D.J. Goyder*, subgen. nov.

Folia ascendentia, margine manifeste revoluta. *Inflorescentia* 4–11-flora. *Corolla* reflexa; pagina abaxialis pubescentia. *Coronae lobi* ad columnam staminalem circa 1 mm super insertionem corollae conjuncti, cucullati; appendix proximalis ad apicem deltato-falcata et apicem styli aequans vel superans impendensque; extremum distale coronae appendice parva ornatum (*A. reenensis*) vel appendice carente (*A. shebae*); sinus profundus rimiformis.

TYPUS.—*Aspidonepsis reenensis* (N.E. Br.) A. Nicholas & D.J. Goyder *vide infra*.

Stems 1, erect, thin, up to 625 mm tall. *Leaves* ascending, linear, occasionally lanceolate, older leaves shorter and broader, margins noticeably revolute. *Inflorescences* 4–11-flowered, bracts present at anthesis and grading in size and shape with leaf system. *Flowers* purple, brown, lilac and yellow. *Corolla* reflexed, lobe apices ascending, abaxial surface pubescent. *Corona* produced high on staminal column, ± 1 mm above corolla; lobes with proximal appendages deltoid-falcate with obtuse apex level with or projecting over style apex, distal end of corona with arm-like appendage reflexed into corona lobe cavity (*A. reenensis*) or without appendage (*A. shebae*). *Staminal column*: anther wings ear-like in outline; anther appendages pescapriform, deeply cleft at apex (*A. shebae*), or ovate to rectangular and occasionally cleft at apex (*A. reenensis*). *Style apex* with slightly thickened, undulate margins. *Pollinia*: distal end noticeably dilated and narrowed towards proximal end. *Erymology*: from the Latin words *ungu(is)* (claw) and *lob(us)* lobe, in reference to the claw-shaped corona lobes of this subgenus (Table 2).

There are two species in subgenus *Unguilobium*, viz. *A. reenensis* (the type species) and *A. shebae*. Both are

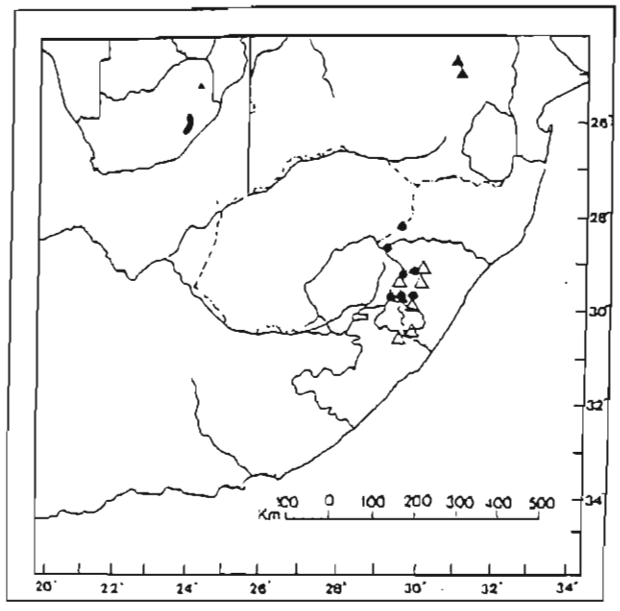

FIGURE 6.—Distribution of *Aspidonepsis cognata*, Δ; *A. reenensis*, ●; and *A. shebae*, ▲.

confined to mountainous areas of the southern African Drakensberg. *A. reenensis* is found in the southern regions of this mountain system (namely Natal), whereas *A. shebae* is found in the northeastern region (the eastern Transvaal). As such, these species are quite widely separated geographically (Figure 6). Although probably related (even if somewhat distantly), they can be easily told apart using corona lobe and anther appendage shape.

4. **Aspidonepsis reenensis** *(N.E. Br.) A. Nicholas & D.J. Goyder*, comb. nov. Type: South Africa, Natal, Van Reenen, *Wood 8635* (K! holo.; GRA!, NH!, PRE!, SAM!, iso.).

Rootstock a tuber, 17–25(–41) × 7–14 mm. *Stems* 1, erect, 240–520(–625) mm long, scabrous. *Leaves* linear, 10.0–56.0 × 0.7–2.5(–4.0) mm, apex acuminate, base cuneate; usually apetiolate or petiole up to 1 mm long. *Inflorescences* occasionally a number massed towards the stem apex, 1–3(–4) per plant, (1–)4–8-flowered; bracts 2.50–5.90 × 0.25–0.50 mm; peduncles (9–)12–65(–75) mm long. *Flowers* (4–)5–7 × 7–11 mm; pedicel 9–15 (–21) mm long. *Calyx* reflexed, lobes lanceolate, apex acuminate, 2.7–4.5 × 1.0–1.7(–2.5) mm. *Corolla*: lobes narrow-elliptic to ovate, 5.5–6.5 × 2.5–3.8 mm, colour (inside and out) dark reddish brown, dark brown, brown, dull reddish purple or purple, margins light yellow or

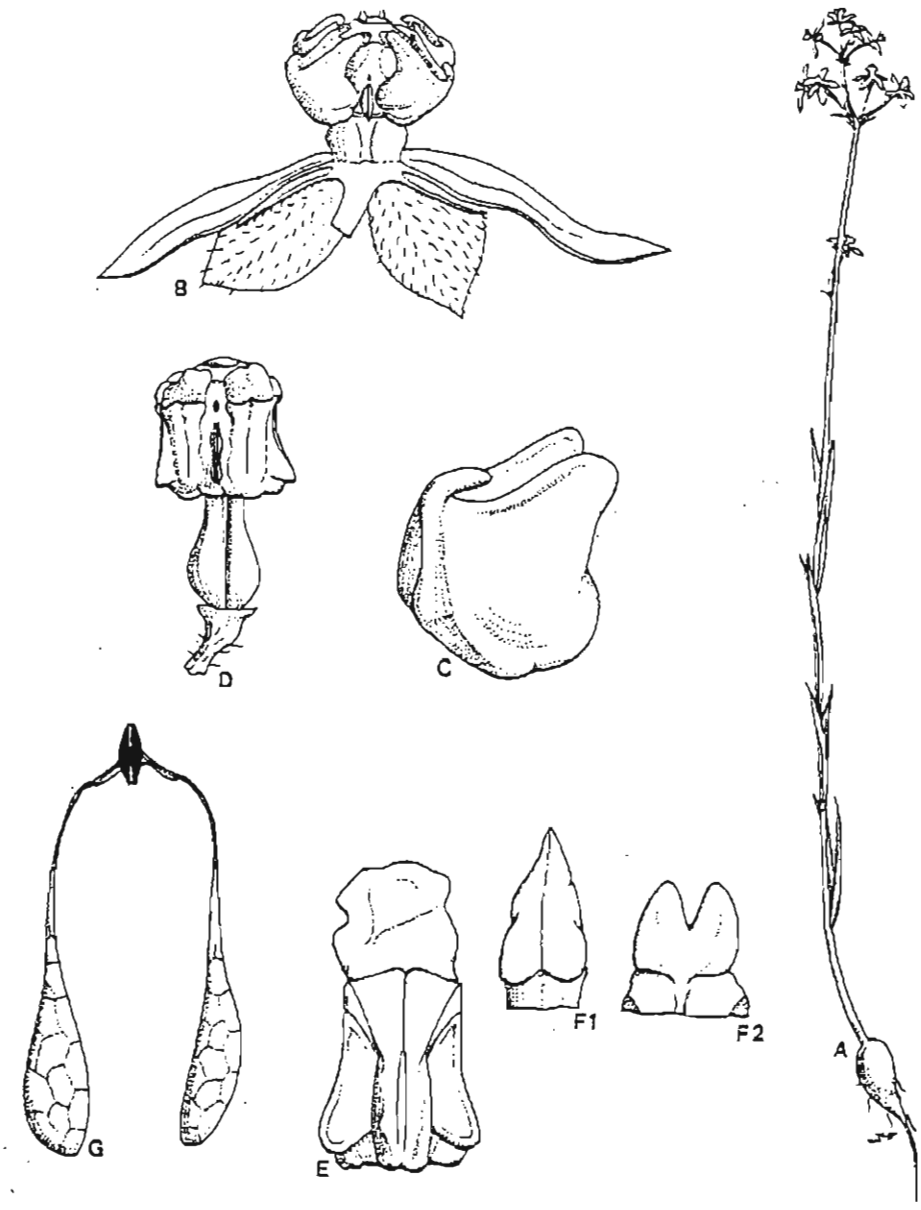

FIGURE 7.—*Aspidonepsis reenensis*. A, whole plant with flowers, × 0.4; B, flower with part of corolla removed, × 7; C, corona lobe, side view, × 12; D, gynostegium excluding corona, × 8.5; E, anther, × 27. F, anther appendage: F1, uncleft, × 12; F2, cleft, × 12; G, pollinarium, × 40. A–E, F2, G, *Killick 1205* (PRE); F1, *Trauseld 1042* (PRE).

purple to white, abaxial surface puberulent to villous, especially in centre and towards the base. *Corona lobes* produced from staminal column 0.8–1.0 mm above corolla, cucullate, almost cyathiform, (1.6–)2.2–2.6 × 1.3–1.8 mm; upper proximal ends forming 2 short, falcate, arm-like appendages with rounded or broad and frilly apices, (0.4–)0.7–1.3 × 0.4–1.0 mm, projecting over or (at least) raised above the style apex; distal appendage short (± 0.5 mm), broad and arm-like, reflexed into the cavity (sometimes totally hidden by sides of lobe), appendage below style apex and almost level with corpusculum. *Staminal column* ± 3 mm tall, slightly inflated in lower portion below each corona lobe; anther wings shaped like an elongated ear lobe, 0.8–1.1 × (0.3–)0.4–0.5 mm; anther appendages ovate to rectangular, appearing wrinkled, white, membranous, occasionally cleft at apex, 0.8–1.5 × 1.0–1.3 mm, decumbent on style apex. *Style apex* truncate with undulate margins, concave with a small central pore, 1.8–2.4 mm wide. *Pollinarium*: corpusculum 0.28–0.34 (–0.40) × 0.12–0.18 mm; translator arms 0.44– 0.64 mm long, thin, transparent; pollinia dilated distally with a long narrow proximal arm-like section, 0.84–1.00 × 0.22–0.28 mm. *Fruits* and *seed* not seen. *Specific epithet etymology*: a latinization of Reenen from Van Reenen's Pass, the type locality of this species (Figure 7).

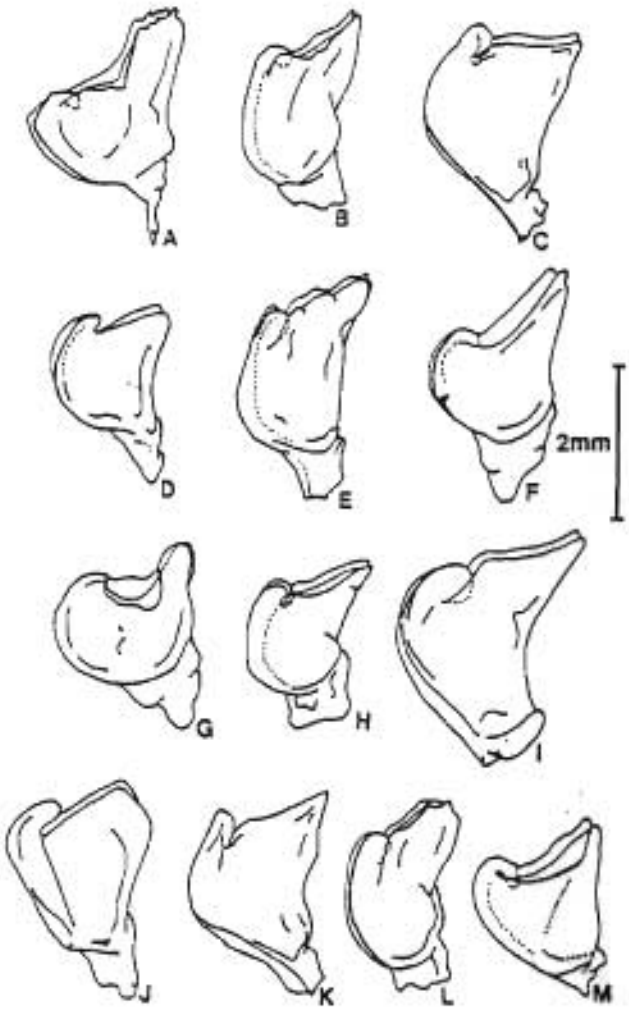

FIGURE 8.—Corona lobe variation in *Aspidonepsis reenensis*. A, *Wood 8635* (PRE); B, *Stewart 2110* (NU); C, *Hilliard & Burtt 7796* (NU); D, *Killick & Vahrmeijer 3654* (PRE); E, *Hilliard & Burtt 9423* (NU); F, *Killick 1205* (NU); G, *Franks s.n. (NH 12112)*; H, *Hilliard & Burtt 9481* (NU); I, *Wood 8635* (NH); J, *Trauseld 1042* (PRE); K, *Hilliard & Burtt 7796* (NU); L, *Rennie 1109* (NU); M, *Wood 8635* (SAM).

A. reenensis grows in dry mountain grasslands, often in sandy situations on top of the Cave Sandstone zone of the Little Berg. It also occurs in *Themeda triandra* veld, which is indicative of a fire climax community (Killick 1963). This species, said by collectors to be frequent to rare, is found in the Natal Drakensberg, from Bushman's Nek in the south to Van Reenen's Pass in the north (Figure 6). It occurs at altitudes varying from 1 500 to 2 100 m, and flowers in the midsummer months, December and January, with one record from November.

Corona lobe structure in the tribe Asclepiadeae is very species-specific and usually uniform within a species (Nicholas 1987). There are however certain exceptions, *A. reenensis* being one of them. The corona lobe structure of this species is extremely variable, although one can still see an underlying, and therefore unifying, corona lobe pattern (Figure 8).

NATAL.—2829: (Harrismith): Van Reenen, (–AD), *Franks s.n. ex Wood 12112* (NH); *Hilliard & Burtt 9481* (NU); *Wood 8635* (GRA, K, NH, PRE, SAM); Mount Manyanyeza, (–AD), *Stewart 2110* (NU); Cathedral Peak State Forest, (–CC), *Killick 1205* (CPF, K, NH, PRE). 2929 (Underberg): Giant's Castle Nature Reserve, (–AD), *Trauseld 1042* (PRE); Highmoor State Forest, (–BC), *Killick & Vahrmeijer 3654* (K, PRE); Cobham State Forest, (–CC), *Hilliard & Burtt 9423* (NU); Garden Castle State Forest, (–CD), *Hilliard & Burtt 7796* (NU); Mawahqua Mtn area, (–DC), *Rennie 1109* (NU).

5. **Aspidonepsis shebae** *A. Nicholas & D.J. Goyder*, sp. nov., *A. reenensi* (N.E. Br.) A. Nicholas et D.J. Goyder affinis sed coronae lobis unguiformibus nec cyathiformibus, appendice proximali brevi falcataque nec rotundata vel fimbriata, appendice distali brachiformi carente differt.

TYPE.—Transvaal, 2430 (Pilgrims Rest): (–DC), Mt Sheba Nature Reserve, *Forrester & Gooyer 216* (PRE!, holo.).

Rootstock a tuber, ± 15 × ± 7 mm. *Stems* 1, erect, 190–340 mm long. *Leaves* linear or occasionally lanceolate, 7–44 × 1–4 mm, older leaves smaller and broader, apex acuminate; usually apetiolate, rarely with petiole up to 0.5 mm long. *Inflorescence* 1–2 per plant, (2–)4–11-flowered; peduncle (5–)19–90 mm long. *Flowers* 4.0–6.5 × 6.0–8.0 mm; pedicel 10–15 mm long. *Calyx*: lobes lanceolate, 3.4–3.6 × 1.1–1.3 mm. *Corolla*: lobes ovate or rarely elliptic, 5.1–5.8 × 3.0–3.6 mm; inside: base pale yellow with a lilac apex, or base lilac with a dark purple apex; outside: base green-yellow with a purple or dark purple apex; margins pale yellow to white; abaxial surface pubescent. *Corona lobes* produced from staminal column ± 1 mm above corolla, claw-like (unguiform), 1.8–3.0 × 2.0–2.1 mm; upper proximal ends extended into 2 short, falcate, subulate appendages projecting over style apex; distal end a square, blunt shoulder which is ± level with style apex; cavity a shallow, central channel ± 0.9 mm deep; yellow in dried specimens. *Staminal column* ± 2.5 mm tall; anther wings ear-shaped, ± 0.7 × 0.4–0.45 mm; anther appendages pescapriform, deeply cleft at apex, membranous, ± 0.5 × ± 0.7 mm, decumbent on style apex. *Gynoecium*: style apex truncate, concave with a small central pore, 1.6–1.8 mm wide; ovaries noticeably pubescent. *Pollinarium*: corpusculum 0.20–0.26 × 0.10–0.12 mm; translator arms 0.28–0.40 mm long; pollinia

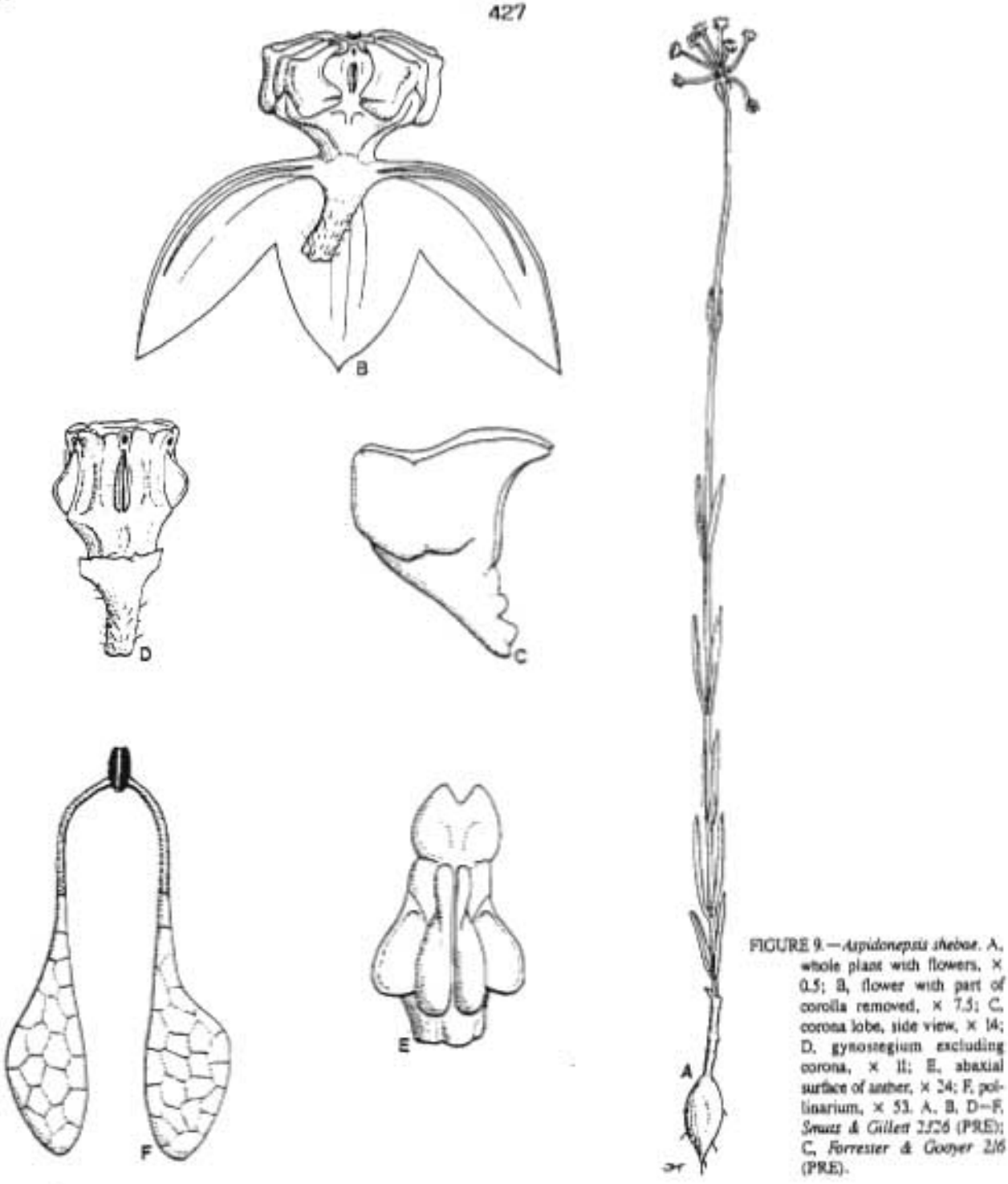

FIGURE 9.—*Aspidonepsis shebae*. A, whole plant with flowers, × 0.5; B, flower with part of corolla removed, × 7.5; C, corona lobe, side view, × 14; D, gynostegium excluding corona, × 11; E, abaxial surface of anther, × 24; F, pollinarium, × 53. A, B, D–F, *Smuts & Gillett 2326* (PRE); C, *Forrester & Gooyer 2/6* (PRE).

clavate, 0.68–0.76 × 0.32–0.36 mm. *Fruits* and *seeds* not seen. *Specific epithet etymology*: a latinization of Sheba from Mt Sheba, the type locality. (Figure 9).

A. shebae probably occurs in montane grasslands, and is restricted to high altitude areas (1 400 to 2 100 m) of the Pilgrim's Rest region of the eastern Transvaal (Figure 6). Plants flower in December-January, and according to one set of collections is said to be frequent.

Vegetatively *A. shebae* is very similar to *A. reenensis*, and it is probably closely related to this species (Table 4). In floral morphology, however, these two species differ greatly, especially in corona lobe structure (Figure 10).

TRANSVAAL.—2430 (Pilgrim's Rest): Mt Sheba Nature Reserve, (–DC), *Forrester & Gooyer 2/6* (PRE); Mauchsberg, (–DC), *Smuts & Gillett 2326* (PRE). 2530 (Lydenburg): Mount Anderson, (–BA), *Smuts & Gillett 2370* (PRE).

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TABLE 4.—A comparison of the two species in subgenus *Unguilobium*. All measurements in mm

Character	*A. reenensis*	*A. shebae*
Stem length	24.0–62.5	19–34
Leaf length	10–56	7–44
Peduncle length	9–79	5–90
Flower colour	Brown & purple	Brown, purple & yellow
Petal length	5.5–6.5	5.2–5.8
* Corona lobe width	1.3–1.8	2.0–2.1
Proximal corona lobe appendage length	0.4–1.3	± 0.5
* Distal corona lobe appendage length	± 0.5	None
* Alar fissure length	0.8–1.1	± 0.7
* Anther appendage length	0.8–1.5	± 0.5
* Anther appendage width	1.0–1.3	± 0.7
* Style apex diameter	1.8–2.4	1.6–1.8
* Translator arm length	0.44–0.64	0.28–0.4
* Corpusculum length	0.28–0.4	0.2–0.26
* Pollinium length	0.84–1.0	0.68–0.76
* Pollinium width	0.22–0.28	0.32–0.36

* characters forming discontinuities between the two taxa.

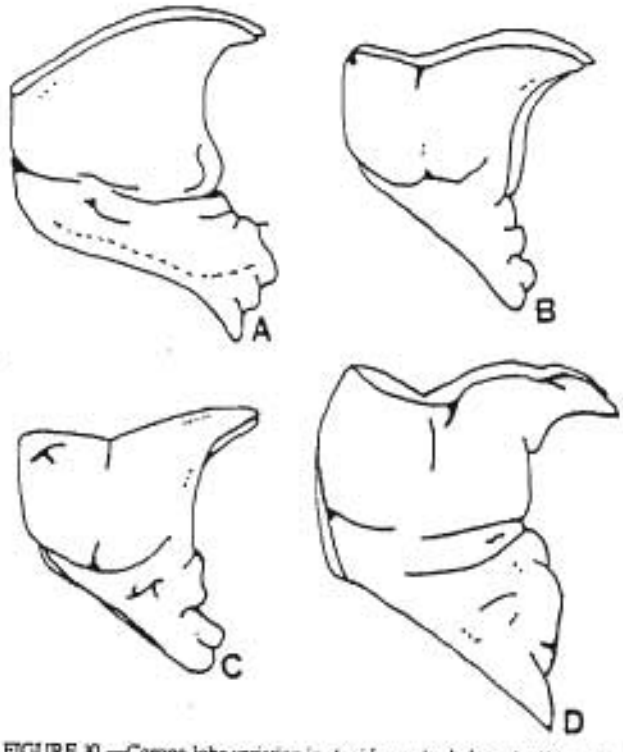

FIGURE 10.—Corona lobe variation in *Aspidonepsis shebae*. A, *Forrester & Gooyer 216* (PRE), × 16; B, *Smuts & Gillett 2326* (PRE), × 15; C, *Smuts & Gillett 2326* (PRE), × 15; D, *Smuts & Gillett 2370* (PRE), × 18.5.

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ASCLEPIADACEAE

VALIDATION OF THE COMBINATION *ASPIDONEPSIS REENENSIS* (ASCLEPIADACEAE): THE TYPE SPECIES OF THE SUBGENUS *UNGUILOBIUM*

In our paper describing the new African genus *Aspidonepsis* (Nicholas & Goyder 1992), the basionym of *A. reenensis* was inadvertently omitted, so invalidating the proposed combination. As this invalid combination is the type of the proposed subgenus *Unguilobium* this too becomes invalid. The present note is intended to correct these omissions.

Unguilobium *A. Nicholas & D.J. Goyder ex A. Nicholas & D.J. Goyder* in *Bothalia* 22: 31, 32 (1992), subgen. nov.

Folia ascendentia, margine manifeste revoluta. *Inflorescentia* 4–11-flora. *Corolla* reflexa; pagina abaxialis pubescentia. *Coronae lobi* ad columnam staminalem circa 1 mm super insertionem corollae conjuncti, cucullati; appendix proximalis ad apicem deltato-falcata et apicem styli aequans vel superans impendensque; extremum distale coronae appendice parva ornatum (*A. reenensis*) vel appendice carente (*A. shebae*); sinus profundus rimiformis.

TYPUS.—*Aspidonepsis reenensis* (N.E. Br.) A. Nicholas & D.J. Goyder *vide infra*.

Bothalia 23,2 (1993)

Aspidonepsis reenensis *(N.E. Br.) A. Nicholas & D.J. Goyder*, comb. nov. Type: South Africa, Natal, Van Reenen, *Wood 8635* (K!, holo.; GRA!, NH!, PRE!, SAM!, iso.)

Asclepias reenensis N.E. Br. in W.T. Thiselton-Dyer, *Flora capensis* 4,1: 1131 (1909).

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REFERENCE

NICHOLAS, A. & GOYDER, D.J. 1992. *Aspidonepsis* (Asclepiadaceae), a new southern African genus. *Bothalia* 22: 23–35.

NICHOLAS A.* & GOYDER, D.J.**

* Botany Department, University of Durban-Westville, Private Bag X54001, Durban 4000, Natal, South Africa.
** The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, England.

CHAPTER 4.3

A REASSESSMENT OF THE MINOR GENERA OF THE SUBTRIBE ASCLEPIADINAE (APOCYNACEAE: ASCLEPIADOIDEAE) IN SOUTHERN AFRICA

"The genus *Asclepias* L. has representatives almost all over the whole world, but its species nowhere reach such splendour as the South African *Pachycarpi* ..."
Schlechter* (1896) on the species later segregated into the genus *Pachyacrpus* by N.E. Brown* (1908).

CONTENTS

* SCHLECHTER, R. 1896. Revision of extra-tropical South African Asclepiadaceae. **Journal of Botany.** 34: 311—315, 417—421 & 449—458.
BROWN, N.E. 1908. *Pachycarpus*, 714—739 in: **Flora Capensis.** 4(1). Thiselton-Dyer, W.T. ed. London, Lovell Reeve & Co.

A REASSESSMENT OF THE MINOR GENERA OF THE SUBTRIBE ASCLEPIADINAE (APOCYNACEAE: ASCLEPIADOIDEAE) IN SOUTHERN AFRICA

A. Nicholas* & H. Baijnath*

Abstract

The following genera, as they occur in southern Africa, are revised: *Kanahia*, *Xysmalobium*, *Pachycarpus*, *Woodia*, *Stenostelma*, *Periglossum*, *Cordylogyne*, *Fanninia*, and *Stathmostelma*. The following new genera and subgenera are described *Trichocodon*, *Xysmalobium* subgenus *Bycanostele*, *Pachycarpus* subgenus *Parapodiopsis* and *Woodia* subgenus *Pseudowoodia*. The following species, subspecies and varieties are also described: *Periglossum podoptyches*, *Pachycarpus dealbatus* subspecies *dianneae* and *Pachycarpus concolor* variety. *transvaalensis*.

Introduction:

Recently we published a reassessment of those southern African species that used to be placed in the genus *Asclepias* L (Nicholas *et al.*, in press). In this paper, we continue our revision of the subtribe Asclepiadinae in southern Africa. Amongst the genera revised here is the problematic genus *Xysmalobium* R. Br. This genus was defined by N.E. Brown (1902 & 1908) to include all those species whose corona-lobe is reduced to a small more or less globose or featureless structure. Unfortunately, due to similar pollination pressure this seems to have happened to the corona-lobe structure of a number of unrelated species. These species have, as a consequence of this false similarity, been placed in the genus *Xysmalobium*; which is as a result paraphyletic. On this point Langley

* Botany Department, University of Durban-Westville, Private Bag 54001, Durban 4000, Natal, South Africa

(1980) also seems to agree and we, like him, have aimed to produce what we believe to be more phylogenetically congruent groups. In southern Africa, *Xysmalobium sensu* N.E. Brown (1907) is consequently reduced from 20 species to only three. Based on leaf and flower structure these three species can be further divided into two subgenera: *Xysmalobium* with two species and *Bycanostele* with one species. The excluded species previously placed in *Xysmalobium sensu lato* are transferred to other genera as follows: five species to *Woodia* Schltr., two to *Stenostelma* and two species to *Pachycarpus* subgenus *Parapodiopsis*. The remaining nine species have being transferred to *Pachyacris* (Nicholas *et al.*, in press).

The other major genus dealt with in this paper is *Pachycarpus*. This remains largely unchanged from Smith's (1988) and Goyder's (1998) treatment of the genus. Section *Campanulati* Schltr. ex Nicholas & Goyder is, however, raised to generic status, but under the name *Trichocodon*. In this genus, what was, *Pachycarpus gerrardii* (Harv.) N.E. Br. is placed as a variety under *T. campanulatus*. Within the subgenus *Pachycarpus* a new variety is also described under *P. dealbatus* E. Mey., and *X. orbicularis* and *X. confusa* (previously in *Xysmalobium*) are transfered to it, but placed in the new subgenus *Parapodiopsis*.

The genus *Woodia*, previously with only three species, is expanded to include five species, transferred from *Xysmalobium*. These five species are accommodated in the new subgenus *Pseudowoodia*. *Xysmalobium gomphocarpoides* subsp. *parviflorum* is raised to specific rank, viz. *Woodia parviflora*.

The genus *Stenostelma*, previously with only three species, is expanded to include nine species transfered from *Xysmalobium* and *Schizoglossum* E. Mey.

The remaining genera are either monospecific or have no more than a total of five species. These are *Kanahia* R. Br., *Parapodium* E. Mey. (reduced from 3 to 2 species), *Fanninia* Harv., *Periglossum* Decne. (reduced from 5 to 4 species), *Cordylogyne* E. Mey. and *Stathmostelma* K. Schum. The genus *Eustegia* R. Br. although previously placed in

the subtribe Asclepiadinae has features such as a triple corona-lobe (probably derived from a double corona) which are anomalous in the subtribe, also there appears to be no close allies amongst the Asclepiadinae. As a result, we propose to removed this genus from the subtribe Asclepiadinae, and will treat it separately at a latter date. *Pentrarrhinum* has already been removed from this subtribe into the subtribe Cynanchinae (Liede & Nicholas, 1992), although this has been contested by Kunze (1997). Liede (1997) has subsequently sunk the Cynanchinae under the Metastelmatinae.

Phylogeny: Where possible, we have attempted to arrange the genera in what we believe to be a reflection of their evolutionary relationship. *Kanahia*, *Xysmalobium*, *Pachycarpus*, *Parapodium* and *Woodia* are all clearly related. *Stenostelma*, *Periglossum* and *Cordylogyne* are also clearly related. *Stathmostelma* is more closely related to tropical African genera and bears much in commom with *Margaretta* and to some extent *Pachycarpus*; as a result we have placed it after *Xysmalobium/Pachycarpus* and allies. *Fanninia* and *Trichocodon*, however, bear little in common with the rest of the genera outlined in this paper. Their affinities lie more with *Aidomene* (Nicholas *et al.*, in press) and some *Schizoglossum* species.

Conservation: One of the advantages that a taxonomic study has over a cladistic study is that the end products of a classification (taxa) have value to conservationist, while the end products of cladonomy (Mayr, 1997) (a cladification composed of clades) are of little use to those involved in ethnobotany, conservation or sustainable management. As a result, we have attempted to assess the conservation status of each taxon dealt with, but these must be used in conjunction with Hilton-Taylor (1996) and Scott-Shaw (1999). However, this does not mean that we place little value on cladistics and a phylogenetic study of the entire subtribe in southern Africa is eventually envisaged by these authors. For more detailed discussion on conservation see Nicholas *et al.*, (in press) and also the discussion on distribution maps below.

Distribution maps: Both here and in Nicholas *et al.*, (in press) we have included distribution maps based on specimens seen by us. quarter degree grids where also purchased from the NBI, but the identity of every specimen used to build this data base was chequed by us during extensive visits to PRE before being used. The point files obtainded in this way were then plotted using the MAPPIT computer program. The maps obtained are both informative and misleading. Misleading because they largely represent the historic rather than actual distribution of the species or infraspecific taxa involved. At least half of the dots on these maps are from collections made 50 or more years ago and represent populations no longer in exsistence. Although the data used to complie them is accurate, the illusion of currency given by these maps should be borne in mind when they are consulted or more importantly used for purposes of conservation.

Key to Genera:

This key is based on these taxa as they occur in southern Africa and may not work for these groups outside of the region.

1a. Plants rheophytic; inflorescences racemose & elongating indefinitely ..... *Kanahia*

1b. Plants not rheophytic; inflorescences umbel-like, not elongating indefinitely 2

2a. Style-apex club-like or trumpet-shaped exerted way beyond the anther-appendages 3

2b. Style-apex if extended beyond the anther-appendages then only slightly so & never club- or trumpet-like 4

3a. Style-apex club-like; leaves linear, 0.7 to 3.5mm wide ..... *Cordylogyne*

3b. Style-apex trumpet-like; leaves never linear,
10 to 80mm wide ..... *Xysmalobium* subgen. *Bycanostele*

4a. Leaves always linear with margins distinctly revolute 5

4b. Leaves linear to suborbicular with margins not revolute 11

5a. Corona-lobes deeply divided into a larger middle lobe with 2 marginally smaller lateral sublobes ..... *Woodia* subgen. *Woodia*

5b. Corona-lobes entire & not deeply subdivided 6

6a. Corona-lobes exerted well beyond the erect corolla tube & curled at the tips ..... *Stenostelma*

6b. Corona-lobes not exerted beyond the corolla if it is erect, or corolla spreading to reflexed 7

7a. Corona-lobes slipper-shaped & horizontal, with large paired wings on the inner upper surface ..... *Trichocodon*

7b. Corona-lobes ligulate, scale-like, tear-drop shaped, cucullate & erect 8

8b. All, or at least some, leaves undulate ..... *Woodia* subgen. *Pseudowoodia*

8a. All leaves smooth & flat, never undulate 9

9a. Leaves much longer than the internodes; petals spreading-reflexed to reflexed ..... *Stenostelma*

9b. Leaves about as long as or shorter than the internodes; petals erect

or spreading erect 10

10a. Corona-lobes cucullate; translator-arms long sinuous & winged ..... *Stathmostelma*

10b. Corona-lobes ligulate or sagittately cordate;
translator-arms short & simple ..... *Periglossum*

11a. Corona-lobes deeply divided into a larger middle lobe with 2 smaller
lateral sublobes ..... *Woodia* subgen. *Woodia*

11b. Corona-lobes entire & not subdivided 12

12a. Staminal-corona connate to the corolla-tube mouth ..... *Parapodium*

12b. Staminal-corona free from the corolla 13

13a. Corolla with argyrocomous hairs ..... *Xysmalobium* subgen. *Xysmalobium*

13b. Corolla without argyrocomous hairs 14

14a. Corona-lobes distinctly horizontal from the base but often erect near
the apex, never divided into sublobes ..... *Pachycarpus* subgen. *Pachycarpus*

14b. Corona-lobes ligulate or scale-like, erect from the base, entire &
simple or divided into a large middle lobe & 2 lateral sublobes 15

15a. Petals 7 to 14mm wide; corona-lobes globular or slightly laterally
compressed ..... *Pachycarpus*

15b. Petals 1.5 to 8mm wide, corona-lobes scale-like & dorso-ventrally
compressed 16

16a. Stems 300 to 1300mm tall; pedicels 9.5 to 25.0mm long; petals 5.5 to 12.5mm long, 3 to 8mm wide; corona-lobes suborbicular ..... *Pachycarpus* subgen. *Parapodiopsis*

16b. Stems 150 to 300mm tall; pedicels 5 to 9mm long; petals 3.75 to 5.5mm long, 1.7 to 3.0mm wide; corona-lobes obovate or subquadrate ..... *Woodia* subgen. *Pseudowoodia*

KANAHIA R. Br., in Mem. Wern. Soc. 1: 38 [1809]. **Type species:** *Kanahia laniflora* (Forssk.) R. Br. (Basionym = *Asclepias laniflora* Forssk.)

Canahia Steud. Nom. Bot. ed. 1: 146 [1821]. **Type species:** As above.

Description: *Habit:* Perennial, multistemmed, tufted, rheophytic shrubs; with milky latex. *Underground organ* woody to fibrous. *Stems* erect, many, solitary or much branching near the base, 0.25—2.5m tall, 4—5mm in diameter, center with a large pith, semi-woody at base, glabrous. *Leaves* simple, opposite, decussate, yellow-green or light green, crowded, spreading-erect, petiolate, pairs linked by a interpetiolar line, small yellow colleters in the axil & along the interpetiolar line; blade usually thickened & coriaceous, linear, linear-lanceolate to lanceolate, 50—200mm long, 4—16mm wide, apex acute, base cuneate, margin entire, midrib depressed along the adaxial surface, prominent below, other veins not visible; petiole 2—9mm long. *Inflorescences* pedunculate, erect, sometimes stout, with a pair of basal bracts, racemose with axis extending indefinitely, 1 produced laterally & extra-axillary at each of the upper nodes, flowers spirally arranged; peduncles 25—80mm long; bracts subtending the flowers small below (3.5 mm) & large above (20mm), clustered & caducous. *Flowers* erect, pedicels produced from between paired bracteoles, 12—50mm long, elongating with age so that flowers on the same inflorescences are all held at more or less the same level (=

corymbose). *Calyx* 5-merous; lobes lanceolate, 3.4—9.0mm long, ±2mm wide, with septal glands at the base. *Corolla* 5-merous, catilliform to spreading reflexed, divided anywhere from half-way to base; lobes elliptic, 9—22mm long, 7—11mm wide, apex subacuminate, both surfaces glabrous, margins with long white woolly hairs, cream, white or pale green, sometimes flushed purple on the abaxial surface. *Staminal-corona* in 1-series, arising at the gynostegial column base or stipitate & arising up to 6.5mm above, 5-merous; lobes erect, fleshy to laterally flattened, slipper-shaped, oblong or small & semiglobose, 2—12mm tall, 2—7mm wide, with a deep central sinus or this reduced to an upper inner groove or solid, upper proximal ends obliquely truncated, round, blunt or tooth-like (then not or only just reaching the style-apex) or produced into 2 long falcate teeth (then projecting over the top of the style-apex or connivent over it), upper distal end blunt & lower than the upper proximal end or blunt to shortly dentate & higher than the upper proximal end, outer margin curved & smooth or with a fleshy keel, inner surface with a deep or shallow groove, white. *Staminal-column*: stoutish: *Anthers* forming small pouches at the base where they join below the anther-wings; anther-appendages transversely oblong, roundish ovate to subcordate-ovate, membranous, inflexed over the style-apex. *Pollinaria:* Pollinia solitary in each anther-sac, pendulous, oblong to oblong-pyriform, turgid (not flattened), attached apically (in pairs) to short horizontal translator-arms; corpusculum oblong, almost as long as the pollinia. *Style-apex* fleshy but truncated, centrally depressed with 5 ridges radiating from the center, with 5 minute style-glands just above where the corpuscula sit. *Follicles* paired or solitary, erect, fusiform & rarely inflated to ellipsoid & inflated, 25—64mm long, 9—30mm wide, apex obtuse to apiculate, smooth & sometimes rugulose, pericarp leathery; pedicels elongating in the fruit. *Seeds* ovate, 3.0—4.5mm long, ±2mm wide, adaxial surface convex, abaxial surface shallowly concave, surface almost smooth with a ±8mm long coma of white hairs apically. *Etymology*: From *Kanakk* the Arabic name for this plant.

Discussion: In his 1902 revision N.E. Brown believed the genus to be composed of four species. Bullock disagreed, saying that differences are due to flowers of different ages being dissected, and reduced them (1952) plus others (1954a) to synonymy under *K. laniflora*. We have continued to follow Bullock here, although we do not agree with his statement that the differences are age related, they do, however, seem to correlated with distribution and a case could be made for giving some of these ecotypes at least infraspecific status. Further detailed study is needed to resolve this interesting problem. Field *et al.* (1986) described another species, *K. carlsbergiana*, bringing the genus, as defined here, to two species; only one of which, *K. laniflora*, occurs in southern Africa. Nicholas (1988) provided data to show that *Kanahia* may have given rise to the genus *Gomphocarpus*; the species *G. rivularis* being almost intermediate between the two (fig. 1 & 2). This supports N.E. Brown's (1902) contention that *Kanahia* is extremely closely related to *Asclepias* (then containing *Gomphocarpus*) and *Xysmalobium*; see also Field, 1986. The realization of this link to *Gomphocarpus*, in fact, goes back to Decaisne (1838). *Kanahia*, *Gomphocarpus* and *Xysmalobium* all have the following important characteristics in common: erect hollow or very pithy stems, white to cream colored flowers, similar gynostegial-column and pollinia structure, and inflated fruits. In the treatment given here, *Kanahia* is placed next to *Xysmalobium* to show this close relationship. The genus *Gomphocarpus* in southern Africa has been treated by Nicholas *et al.* (in press). The table below explores the similarities and differences between these three genera:

Table 1. Differences and similarities between *Kanahia*, *Gomphocarpus* and *Xysmalobium*

Character	***Kanahia***	***Gomphocarpus***	***Xysmalobium***
Rootstock	Woody to fibrous	Fibrous	Woody stem-tuber

Habit	Shrubby & rheophytic	Shrubby & rheophytic or shrubby herb	Geophytic herb, sometimes shrubby
Colleters in leaf axil conspicuous	Yes	Yes or No	No
Inflorescences	Flowers spirally arranged around an elongating axis	Umbel-like. Flowers originating from the same point	Umbel-like. Flowers originating from the same point
Inflorescence orientation	Erect	Pendulous	Erect to pendulous
Corolla orientation	Spreading to reflexed	Reflexed	Erect
Corona-lobes	Sac-like or solid	Sac-like	Solid
Follicle pedicel orientation	Erect	Recurved	Recurved
Follicle surface	Smooth	Usually densely covered in long bristles, occasionally smooth or smooth with longitudinal ridges bearing stout spines	Densely covered in long bristles or smooth with longitudinal ridges bearing stout spines

There is also some similarity between *Kanahia* and *Pachycarpus*, *Calotropis*, *Margaretta* and possibly *Pentasachme* (another rheophyte). In fact, Bullock (1954) mentions that the corona-lobes of *Pachycarpus* "recalls the corona-structure of *Kanahia laniflora*." The colleters in the leaf axils are not unusual and can also be found in other Apocynaceae, however, the colleters found along the prominent interpetiolar-line seem to be unique; see also Field *et al.*, 1986.

Distribution: From South Africa through tropical Africa to Arabia and India.

1 ***Kanahia laniflora*** (Forssk.) R. Br., in Mem. Wern. Soc. 1: 40 [1809]. **Type**: *Forsskål s.n.*, Yemen, Djöbla [Holo. C; Iso. BM].

Asclepias laniflora Forssk., Fl. Aegypt-Arab.: 51 [1775]. **Type**: As above.

Kanahia kannah Schultes, in Roem. & Schults, Sys. Veg. 6: 94 [1820], *nom. superfl.* **Type**: As above.

Kanahia forskalii Decne., in DC. Prodr. 8: 537 [1844], *nom. superfl.* **Type:** As above.

Kanahia laniflora Del., Cent. Pl. d'Afr. Voy. Caillaud: 49 & t. 64 [1826], *nom. illeg. non* Forssk. Fl. Aegypt-Arab.: 51 [1775]

Canahia laniflora Steud., Nom. Bot. ed. 1: 146 [1821]. **Type:** As above.

Kanahia delilii Kotschy ex Decne., in Ann. Sc. Nat. sér., 2(9): 330 [1838]. **Type:** *Caillaud s.n.,* Sudan, Mt. Aqarô or Aquarô [Holo MPD].

Gomphocarpus glaberrimus Oliv., in Trans. Linn. Soc. 29: 110 & t. 120 [1875]. **Type:** *Speke & Grant s.n.,* Tanzania, Marenge M'Khali. c. 1000m [Holo. K].

Asclepias glaberrima (Oliv.) Schltr., in Journ. Bot. 33: 335 [1895]. **Type:** As above.

Kanahia glaberrima (Oliv.) N.E. Br., in Fl. Trop. Afr. 4(1): 297—298 [1902]. **Type:** As above.

Kanahia consimilis N.E. Br., in Fl. Trop. Afr. 4(1): 298 [1902]. **Type:** *Bates 322,* Cameroon, Lobo River near Batangs, on rocks left bare by low water [Lecto. K].

Asclepias coarctata S. Moore, in Journ. Bot. 46: 297 [1908]. **Type:** *Swynnerton 248,* Mozambique, Lower Umswirizwi River, c. 300m [Syn. BM. Isosyn. K]. *Swynnerton 1895,* Mozambique, Lower Buzi River, c. 100m [Syn. BM; Isosyn. K].

Kanahia monroi S. Moore, in Journ. Bot. 49: 156 [1911]. **Type:** *Monro 1100,* Zimbabwe, Victoria [Holo. BM].

Asclepias rivalis S. Moore, in Journ. Bot. 52: 337 [1914]. **Type:** *Gossweiler 5771,* Angola, Lucalla River [Holo. BM].

Asclepias fluviatilis A. Chev., Asclepiadaceae, 428—440, in: Exploration Botanique de L'Afrique Occidentale Francaise. vol. 1. *nom. nud.*

Figure 1. Comparison of the morphology of *Kanahia laniflora*, *Gomphocarpus physocarpus* and *G. rivularis*, illustrating the intermediate nature of the later taxon between *Kanahia* & *Gomphocarpus*. a. Flowering stem: a1. *K. laniflora;* a2. *G. rivularis* &; a3. *G. physocarpus*. b. Colleters: b1. At the leaf axil & on the interpetiolar scar in *K. laniflora*; b2. In the leaf axil & on petiole base in *G. rivularis* (colleters are absent from all other *Gomphocarpus* species). c. Inflorescence arrangement: c1. Corymbosely arranged inflorescences in K. laniflora; c2 racemosely arranged inflorescences in *G. rivularis* and all other *Gomphocarpus* species.

Discussion: The synonomy and types given above are following Bullock (1952). Plants are found growing in rivers (often seasonally flowing) on sandy or rocky river beds (van Steenis, 1981), often with the base inundated for weeks or months (Dyer, 1943). Figured in Field *et al.* (1986), where a very nice, illustrated comparison, is given of the gynostegial-column (including corona) of the different ecotypes of this species. Also figured in Dyer (1943), who mentions that the seeds are viviparous, i.e. germinating before dispersal from the fruit. Because of this, the coma of hair at the end of the seed is often dispensed with. (Fig. 1 & 2)

Distribution: African-Arabian endemic. South Africa [Mpumalanga & Northern province] north to Arabia and west to Ivory Coast, but skirting the Congo basin. Fig. 3.

Conservation Status: Low Risk (Least Concern). The flow of many rivers in South Africa are negatively impacted on by the building of dams and the use of vast quantities of water to irrigate farmlands. Many rivers are also polluted by surrounding communities and industries insensitive to the environment. As a result, this species must be considered vulnerable in this country, except perhapse where it occurs in the Kruger National Park.

Representative Specimens: South Africa: Northern: *Galpin 13520*, Pietersburg region [NH]; *Lambinon 82/97 with Reekmans*, Kruger National Park [PRE]; *Vahrmeijer 1522*, Beit Bridge, Limpopo river bed [NH, PRE]; *Zambatis 1377*, Klaserie Private Nature Reserve [PRE]; *Riley 1960*, Messina [PRE]; *van der Schijff 1039*, Kruger National Park, Shingwedzi [PRE]; *Codd 4100*, Overvlakte farm, near Watchtower on Limpopo [PRE]; *Lang s.n.*, Makuleke [PRE 32232]; *Moss & Rogers 17759*, Pietersburg [PRE]; *Bruce 45*, Dongola, Limpopop [PRE]; *Galpin 13520*, 50kms north of Gravelotte Station [PRE flowers & fruit]; *Dyer 4299*, Dongola Reserve, Limpopo [PRE flowers & fruit]; *Lambinon 82/97 with Reekmans*, near Tshange-lookout [PRE]; *van Rooyen & Bredenkamp 576*, Kruger National Park, Mhlangene, Letaba river [PRE]. Mpumalanga: *Story 3963*, Near Olifants Gorge Rest Camp [GRA, PRE]; *Codd & Dyer 4658*, Shingwedzi [PRE]; *Zimbatis 872*, Olifants river [PRE]; *van der Schijff 528*, Kruger

National Park, Olifant River Gorge [PRE]; *van Wyk PV & NF 4637*, Kruger National Park, Olifants River Brudge [PRE].

Mozambique: *Ward 7778*, Gorongosa National Park [NU]. **Zimbabwe:** *Chase 338*, Hotsprings near Mutari [NU]; *Evans s.n.*, near Umsweswe [NU].

Excluded Southern African Names

K. glaberrima (Oliv.) N.E. Br. = ***K. laniflora* (Forssk.) R.Br.**

XYSMALOBIUM R. Br., in Mem. Wen. Soc. 1: 39 [1809]. **Type species:** *Xysmalobium undulatum* (L.) Ait.f. (Basionym = *Asclepias undulata* L.)

Xysmalobium R. Br. section *Euxysmalobium* K. Schum., in Engler & Prantl Pflzfam. 4(2): 232 [1895].

Xymalobium Steud., Nom. Bot. edn. 2. 2(2): 245 [1841].

Description: *Habit:* Stout perennial herbs, sometimes appearing almost shrubby; with milky latex. *Underground Organ* a very large much fissured stem-tuber. *Stems* 1—9, erect, simple or branched from near the base, 0.1—1.8m tall, 5—25mm thick, produced annually, very fibrous & with a large pith. *Leaves* opposite, spreading-erect to erect, petiolate; lamina linear, linear-lanceolate, lanceolate, lanceolate-attenuate, ovate-lanceolate, oblong-lanceolate, elliptic, broadly elliptic-oblong to oblong, 55—270mm long, (10-)15—80mm wide, apex acuminate, subacute to acute & mucronate, rarely obtuse or emarginate, base subcuneate, obtusely tapering, rounded, cordate to truncate, sometimes clasping the stems, margins undulate or flat, both surfaces pubescent to glabrous or slightly glaucous, margin scabrous, venation especially midvein prominent; petiole stout, 1.5—8.0(11.0)mm. *Inflorescences* erect, umbel-like, subglobose to globose, pedunculate or rarely sessile, produced lateral at the nodes or terminal, 8—35-flowered;

peduncles usually 13—76mm long, stout & pubescent. *Flowers* campanulate to globose campanulate (with gynostegial-column or exposed), divided to the base, white, creamy green, yellow, brown, pink or purple; pedicels 10—21mm long. *Calyx* 5-merous; lobes usually linear-lanceolate, lanceolate or narrowly ovate, 3—10mm long, 0.75—4.8mm wide, apex acute to pointed, glabrous with unbranched multicellular hairs along the margin, pale to bright green with apex purple or cream tinted maroon. *Corolla* 5-merous; lobes erect, concave in the basal half, reflexed or spreading at the apex, broadly elliptic-oblong, oblong to ovate-lanceolate, 5—15mm long, 2.8—8.5mm wide, apex acute, recurved, shortly bifid or with a small terminal notch, margins sometimes slightly revolute, abaxial surface glabrate to shortly pubescent with unicellular hairs, adaxial surface glabrous in the lower half, sometimes the recurved tips densely covered in stout white argyrocomous clavate hairs 0.5—1.0mm long or glabrous. *Staminal-corona* pseudomonoseriatate, arising at the gynostegial-column base. *Outer-corona* 5-merous, alternating with the corolla; lobes small, thick, fleshy, shortly spreading at the base then erect, dorso-ventrally flattened, subquadrate, suborbicular, subrhomboid, subtriangular or broadly deltoid-ovate, 2—5mm long, 1—5mm wide, base sometimes shortly stalked or broadly cuneate to subtruncate & notched, upper margin obtusely rounded, inner surface with a small linear keel running the length, sometimes grooved on either side & with 2 lobules at the base, outer surface obtuse & gibbously keeled or convex, margins contiguous, shorter than the style-apex, white or cream with apical margin purple or green, brownish or pale maroon. *Inner-corona* vestigial reduced to a small bump-like swelling. *Staminal-column* constricted below the anther-wings, 1.0—6.5mm long. *Anthers*: Anther-wings subquadrate produced into a truncate tooth at or near the base, 0.3—3.0mm long; anther-appendages ovate, elliptic, rounded, suborbicular, triangular or sometimes rhomboid, 0.7—2.5mm long, 1.6—2.2mm wide, incumbent on the style-apex or erect, white, membranous. *Pollinaria*: Pollinia pendulous, solitary in each anther-sac, flattened, oblong-curved or club- to pear-shape in outline, attached terminally or

subterminally; translator-arms stout to narrow; corpusculum ovate to ovate-elliptic. *Style-apex* truncate & concave at the very apex, shortly conical or trumpet-shaped, level with or produced above the anthers, stigma-lobes cushion-like. *Follicles* erect, solitary, inflated, obliquely ovoid, oblong-oblique or fusiform, 72—110mm long, 15—20mm wide, densely covered in long recurved 20mm long bristles or glabrous with several longitudinally thickened ridges bearing stout recurved spines or pubescent. *Seeds* flatish, ovate, 5—8mm long, 2.5—4.5mm wide, surface rugulose. *Chemistry:* Cardenolides, which affect heart muscle, have been found in this genus. *Etymology:* From the Greek *xysma* (= thread) & *lobos* (= lobes), either in reference to the echinate follicles or simple corona-lobes.

Discussion: It seems that almost every botanist who has dealt with the genus in the last 100 years has seen it as a heterogeneous assemblage of species, except possibly for N. E. Brown (1902 & 1907). Bullock (1952) in reference to the genus on the whole of the African continent commented that it should contain only *X. undulatum* and that all other species not conspecific with it should be transferred to other genera. As Langley (1980) points out, the species of this genus, as defined by N.E. Brown, are united only by the solid fleshy and reduced nature of their corona-lobes. Langley felt that the species involved could be subdivided into six natural groups, which he suggested should all receive generic status. Although we agree with his groups, we do, however, differ in the rank at which we believe they should be recognized. We have also expanded some groups to include species from *Asclepias* and *Schizoglossum sensu* N.E. Br. Langley was, of course, looking at the genus *Xysmalobium sensu* N.E. Brown only, we, on the other hand, have tended to see his natural groups in the context of the entire subtribe Asclepiadinae, thus, accounting for the differences in opinion expressed here. The differences between Langley's 1980 classification and the one presented here can be summarized as follows:

- *Xysmalobium* is treated by Langley as having only two species, we believe it to have three. *
- His genus *Bycanostele** we have treated as a subgenus under *Xysmalobium*.
- *Parapodiopsis** has been reduced to subgeneric rank under *Pachycarpus*.
- *Saxymolobium** has not been accepted. *X. involucratum* placed in this genus by Langley is treated by us as part of *Stenostelma*. *S. zeyheri* has been raised from synonymy under *S. involucratum*.
- *Pseudowoodia** has been treated as a subgenus under *Woodia*.
- *Pachyacris* has been accepted as outlined by him but species previously in *Asclepias* have also been included (Nicholas *et al.*, in press).

Langley attached *determinavit* labels to many herbarium specimens using these names, indicating his intention to publish them in collaboration with J. Stewart. However, 18 years have passed since the completion of his well produced M.Sc., and we have had to assume that they will not be validly and effectively published by him.

Scott-Elliot (1890) suggested that the genus can be regarded as an off-shoot of *Pachycarpus* and that it is also closely related to *Gomphocarpus*. We partly concur with his findings, it is without doubt closely related to these two genera, and to *Kanahia*, and may have had a common origin with one or all of them.

Distribution: African endemic. Southern Africa in Botswana, Lesotho, Namibia, South Africa [all provinces] and Swaziland. Also further north in Africa to Angola and Kenya.

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* Names not validly or effectively published.

Key to Subgenera:

1a Style-apex truncated &, in southern African specimens, not extended beyond the anthers ..... Subgenus *Xysmalobium*

1b Style-apex trumpet-shaped & much extended beyond the anthers ..... Subgenus *Bycanostele*

XYSMALOBIUM* R.Br. Subgenus *BYCANOSTELE* Stewart & Langley ex Nicholas** *subgen. nov.* ***Caulis *crassus, simplicex, 150—350mm.* ***Folio*** *oblong-lancolato ad elliptico, 70—150mm longus, 30—80mm latus, basibus cordato ad truncato, ubi maturus aliquando caulibus amplectens, marmarginem plano.* ***Floris*** *campanulatis, cremeus ad atroroseus.* ***Corolla*** *latus elliptico ad oblongo, 5—10.5mm longo, 2.8—8.5mm latus, glabre.* ***Coronae lobus*** *0.5—1mm supra columna-gynostegio exorientia, simplicex, carnosus, subquadratis, 2.4—3.2mm longo, 1.2—2.5mm latus.* ***Stylus-stigmate-capitulo*** *tubatus, apicis expanso et peltato. Folliculis aliquantum inflato.* **TYPUS:** *Xysmalobium woodii* N.E. Br., *vide infra.*

Bycanostele Stewart & Langley, in Langley, M.Sc. Thesis (1980). Name not validly or effectively published.

Description: *Underground organ* a woody turnip-like stem-tuber, 150mm long, 250mm wide, surface corky, fissured & pitted corky surface. *Stems* solitary or 2, stout, unbranched, 150—350mm tall, 5—25mm wide. *Leaves* 3—6 per plant, petiolate; lamina oblong-lanceolate, oblong, broadly elliptic-oblong to elliptic, (70-)84—123(-150)mm long, (30-) 49—55(-80)mm wide, apex acute to obtuse & more or less mucronate, emarginate on the lower leaves, base cordate, rounded, truncate, sometimes also oblique, mature leaves sometimes clasping the stem, margins entire & flat, adaxial surface glabrate, abaxial surface glabrous to glabrate; petiole flat, 2—4(-7)mm long. *Inflorescences* erect, pedunculate, globose, 1—4 per stem, produced laterally from the

upper nodes, 16—20-flowered; peduncles stout, 47—60mm long. *Flowers* campanulate; pedicels 10—13mm long with multicellular hairs. *Sepals* linear-lanceolate, narrowly ovate to elliptic, 3—5(-7)mm long, 0.75—1.5mm wide, apex subacute to acute, adaxial surface glabrous, abaxial surface with multicellular hairs, cream tinged maroon. *Petals* broadly elliptic, elliptic-oblong to oblong, 5.0—10.5mm long, 2.8—8.5mm wide, concave below, spreading above, apex obtuse, with a small oblique notch, adaxial surface glabrate, abaxial surface glabrous, cream shaded to deep rose at the tips. *Staminal-corona* arising 0.5—1.0mm above the gynostegial-column base; lobes subquadrate, 2.4—3.2mm long, 1.2—2.5mm wide, apex obtusely pointed, base broadly cuneate, subcordate or truncated & notched, inner surface with a longitudinal fleshy ridge which is grooved on either side, with 2 minute lobules at the base, outer surface convex, lateral margins contiguous. *Staminal-column* 1.0—3.5mm tall. *Anthers*: Anther-wings subrectangular, 0.3—0.5mm long; anther-appendages erect or spreading erect under the style-stigma-head, triangular, 0.7—1.0mm long, apex obtuse. *Style-stigma-head* trumpet-like, arising about 2mm above the corona-lobes, expanding at the apex, 3.8—5.0mm wide, peltate with a central depression. *Pollinaria*: Pollinia oblong-ovoid & curved, attached subterminally; translator-arms thin; corpusculum ovate-elliptic. *Follicles* fusiform, 100—110mm long, 15—20mm wide, more or less inflated, apex acute, surface puberulous; pedicels stout 130mm long in fruit. *Seeds* 7—8mm long, 4.0—4.5mm wide. *Etymology:* From Latin. *Bycano* is a modification of *buccinatus* (= trumpet-shaped) and *-stele* (= column). This is in reference to the elongated trumpet-shaped style-stigma-head.

Discussion: Distinguished from subgenus *Xysmalobium* by its lack of argyrocomous hairs on the petal tips, more spreading corolla, style-stigma-head trumpet-like and produced above the anthers, anther-appendages erect or almost so, and pollinaria smaller with translator-arms thin and pollinia differently shaped. This monospecific taxon is intermediate between *Xysmalobium* and *Calotropis*. This connection with *Calotropis* was first noted by Dyer on a herbarium specimen housed at PRE [*Trauseld 117*]. *Calotropis*; a

genus common in drier parts of Africa and tropical of Asia and Australia. Subgenus *Bycanostele* has the following characters in common with *Calotropis*: same flower color, similar leaf structure and texture, corona well below the level of the style-apex and large smooth inflated follicles. However, *Calotropis* is a genus of shrubs or small trees and has a quite differently shaped corona, which consists of two large lateral wing-like sublobes and a basal tail. The pollinaria of this taxon are also quite unlike those of *Calotropis*. *Bycanostele* has the following characteristics in common with *Xysmalobium*: Same type of stem-tuber, same stature and habit, similar leaf structure and leaf texture, and similar corona-lobes. Although, a good case could be made for placing this species in a genus of its own, we have opted to place it in *Xysmalobium* as a subgenus. The similarities discussed above are, however, probably not co-incidental. Looking at the totality of characteristics, including their widespread distribution (which can be interpreted as plesiomorphic, viz. the premis that common and widespread is primitive) we are in little doubt that *Kanahia*, *Gomphocarpus*, *Xysmalobium*, *Pachycarpus*, *Calotropis* and *Margaretta* are all closely related. This subgenus is monospecific.

Distribution: South African endemic. [KwaZulu-Natal province (Drakensberg only)].

1 ***Xysmalobium woodii*** N.E. Br., in Fl. Cap. 4(1): 1130 [1909]. **Type**: *Wood 10830,* South Africa, KwaZulu-Natal province, near van Reenen, 1524 to 1829m [Holo. K; Iso. NH].

Xysmalobium trauseldii R.A. Dyer, in Bothalia 10(3): 433—434 [1971]. **Type**: *Trauseld 1107,* South Africa, KwaZulu-Natal province, Estcourt District, Giants Castle Game Reserve, 05.11.1969, rare, 5800ft (= 1768m) [Holo. PRE with rootstock & photo]. Reduced to synonomy here.

Discussion: It has been difficult to decide whether this species should be placed in a genus of its own or not. Both N.E. Brown (1909) and Langley (1980) mention that it is

unique within the genus. To an extent this is true but just how significant these differences are is hard to gauge. The stem-tuber of this species is exactly like those of the other two species placed here in *Xysmalobium* and the leaf-shape is also similar to some specimens of *X. undulatum*, including the sometimes cordate base. The thin texture and the fact that the mature leaves usually clasp the stem is different, but certainly not enough to warrant generic status. The flowers differ in being pale pink or a dark rosy colored, however, creamy ones (similar to *X. undulatum*) are also produced, so this too does not warrant the allocation of generic status. The petals differ in being glabrous and do not bear clavate argyrocomous hairs. The corona-lobe structure is almost exactly the same as for the other two species include here in *Xysmalobium*. This leaves just the style-stigma-head which projects beyond the anthers, but this phenomenon can also be seen in *X. angolense* (included in *X. undulatum* by Bullock). However, the degree of projection and the trumpet-shaped (5-crenulate almost peltate) style-apex that overlaps the staminal curtain is unique. It is, thus, felt that generic status is not warranted, but that due to the unique shape of the style-stigma-head and lack of agyrocomous hairs this taxon at least deserves subgeneric rank under *Xysmalobium*. To all this, of course, are the many similarities with *Calotropis*. *X. woodii* grows in damp, black soil amongst grasses and sedges. It is found at altitudes of between 1370 and 1800 meters, and flowers from October to January (Langley, 1980).

Distribution: Southern African endemic. Lesotho and South Africa [KwaZulu-Natal province only] (fig. 3).

Conservation Status: This species is not often encountered and even though it occurs in *KwaZulu-Natal Conservation Services* areas it should be considered vulnerable.

Representative Specimens: Lesotho: *Bayliss s.n.*, without precise locality [PRE slide with print only]. **South Africa:** KwaZulu-Natal: *Trauseld 117*, Mont-aux-Sources National Park [PRE]; *Trauseld 678*, Giant's Castle Game Reserve, Bushman's river [PRE].

XYSMALOBIUM* R.Br. Subgenus *XYSMALOBIUM

Description: *Stems* 1—9, simple or branched from near the base, 0.1—1.8m tall, 12—19mm thick at the base tapering upwards, more or less hollow inside. *Leaves* spreading-erect to erect; lamina linear, linear-lanceolate, lanceolate, lanceolate-attenuate, ovate-lanceolate to oblong-lanceolate, 55—270mm long, (10-) 15—78mm wide, apex pointed, subacute to acute & mucronate, rarely obtuse, base subcuneate, obtusely tapering, rounded to subcordate, margin usually undulate, occasionally flat, vestiture on both surfaces pubescent to glabrous or slightly glaucous, margin scabrous; petiole stout, flat adaxially. *Inflorescences* erect, subglobose to globose, rarely sessile, usually pedunculate, 8—35-flowered; peduncles 13—76mm long, stout & pubescent; bracts linear to linear-lanceolate, 4—5mm wide, 7—11mm long, apex acute to attenuate, long with multicellular hairs. *Flowers* campanulate to globose-campanulate with gynostegial-column hidden, 10—18mm in diameter, white, creamy green, yellow, brown or shaded purple; pedicels chaneled adaxially, densely pubescent, 10—21mm long. *Sepals* usually lanceolate, sometimes linear or narrowly ovate, 4—10mm long, 1.5—4.8mm wide, apex acute to pointed, glabrous with unbranched multicellular hairs along the margin, pale to bright green with apex purple, septal colleters or squamellae elliptic, narrowly ovate to ovate, rarely linear-lanceolate or flat, membranous & irregularly shaped, 0.75—1.75mm long, 0.25—0.45mm wide. *Petals* erect, concave in the basal half, reflexed at the apex, broadly elliptic-oblong, oblong to ovate-lanceolate, 5.5—15.0mm long, 3.4—7.0mm wide, apex acute, recurved or shortly bifid, margins sometimes slightly revolute, adaxial surface glabrate to shortly pubescent with unicellular hairs, adaxial surface glabrous in the lower half, the recurved tips densely covered in stout white argyrocomous clavate hairs 0.5—1.0mm long. *Staminal-corona* arising at the gynostegial-column base; lobes suborbicular, subrhomboid, subtriangular or broadly deltoid-ovate, 2—5mm long, 2.5—

5.0mm wide, base sometimes shortly stalked, upper margin obtusely rounded, inner surface with a small linear keel running the length, outer surface obtuse & gibbously keeled, lateral margins contiguous, apex shorter than the style-apex, white or cream with apical margin purple or green, brownish or pale maroon. *Staminal-column* constricted below the anther-wings, 4.5—6.5mm long. *Anthers*: Anther-wings 1—3mm long; anther-appendages ovate, elliptic, rounded, suborbicular or sometimes rhomboid, 0.7—2.5mm long, 1.6—2.2mm wide, incumbent on the style-apex, white & membranous. *Pollinaria*: pollinia club- or pear-shaped, attached terminally; translator-arms stout; corpusculum oval. *Style-apex* truncate & concave at the very apex or shortly conical, stigma-lobes cushion-like. *Follicles* obliquely ovoid, oblong-oblique or broadly fusiform, apex stout & pointed, 72—105mm long, 21—50mm wide, densely covered in long recurved 20mm long bristles or glabrous with several longitudinally thickened ridges bearing stout recurved spines; pedicel recurved in the fruit.

Discussion: This subgenus is distinguished from the other subgenus, *Bycanostele*, by its more erect petals with the recurved tips bearing argyrocomous clavate hairs, the style-apex not exceeding the anthers and much larger pollinaria. Towards the end of this study a specimen (*Dieterlen 189* in PRE) was discovered that is vegetatively somewhat intermediate between *X. undulatum* and *X. stockenstroomense*, but the corona-lobe is quite distinct. This Lesotho specimen (fig. 7) may prove to be a new species, but as the specimen concerned is only a fragement we have been unable to persue this further. Species belonging to this subgenus are usually found growing in grasslands.

Distribution: As for the genus.

Key to Species:

1a Plants tall, usually 1.0 to 1.8 meters; stems not glaucous; follicle surface densely covered in long hair-like processes ..... *X. undulatum*

1b Plants short, 0.1 to 0.8 meters; stems glaucous, follicles glabrous but with a few ridge-like lines running the length & bearing recurved short spines ..... *X. stockenstromense*

2 *Xysmalobium stockenstromense* Scott-Elliot, in Journ. Bot. 28: 364 [1890]. **Type**: *Scully 169,* South Africa, Eastern Cape province, scrub on the slope of Lushington Mountain, near Stockenstroom, Dec. 1884 [Holo. K.]

Gomphocarpus stockenstromensis (Scott-Elliot) Schltr., in Bot Jahrb. 20(5). Beibl. 51: 37 [1895]. **Type**: As above.

Asclepias stockenstromensis (Scott-Elliot) Schltr., in Journ. Bot. 34: 454 [1896]. **Type**: As above.

Discussion: This species differs from *X. undulatum* in its shorter stems (less than 800mm tall), leaves erect and crowded together due to shorter internodes. The leaves are glaucous and always glabrous, except on the margins, the lamina tends to be more or less folded downwards on either side of the midrib. The inflorescences are usually surrounded by the leaves and not emerging fully from them. One of the most noticeable differences is the fruit which is glabrous with several longitudinal ridges adorned with stout recurved spines, instead of densely covered in long filiform processes (fig. 5). This species is also found at higher altitudes, 1200 to 2590 meters, than *X. undulatum* and flowers from November to January. Illustrated in Langley, 1980.

Distribution: Southern African endemic. Lesotho and South Africa [North West, Gauteng, Free State, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] (fig. 3).

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Threatened in some areas.

Representative Specimens: Lesotho: *Jacot Guillarmod 3900*, Butha Buthe district, above Soloane [PRE]; *Schmitz 8566*, On way to Qiloane falls [PRE]. **South Africa:** Gauteng: *Schlechter 4134*, near Donkerhoek [K]. Mpumalanga: *Collins s.n.*, Ermelo [PRE 13711]; *Cameron 400*, Dullstroom [PRE], *Devenish 236*, Oshoek, Wakkerstroom district.. Free State: *Bolus 8114*, Bester's Vlei [GRA NU, PRE]; *Flanagan 2068*, Witsiehoek [PRE]; *Liebenberg 7523A*, Generaalskop [PRE]; *Potts 3091*, Fouriesburg [BLFU, PRE]; *Jacobsz 4863*, Qwa Qwa, near Sentinel [PRE]; *Leendertzz s.n.*, Belfast [PRE 7966]. KwaZulu-Natal: *Nicholas 2719 with Poorun*, near Nottingham [UDW]; *Nicholas 2731 with Poorun*, Sunset farm, Underberg district [UDW]; *Goyder 3937 with Nicholas*, between Kamberg & lower Loteni [K]; *Killick 1203*, Cathedral Forest Station [PRE]; *Manning, Hilliard & Burtt 16041*, Cobham Forestry Reserve [PRE]; *Hilliard & Burtt 17432*, Tarn Cave above Bushman's Nek [PRE]; *Wood 10829*, Bushmans river valley [NH]; *Wylie s.n.*, Greytown [NH 21642]; *Young s.n.*, Ionwood, Rosetta [NH 20983]. Eastern Cape: *Haygarth ex Wood 4172,* near Kokstad [NH 6065 with illustration]; *Phillipson & Hutchings 152*, Elandsberg, Seymour [UFH]; *Boardman 209*, Ramatselisos Gate [PRE].

3 ***Xysmalobium undulatum*** (L.) W.T. Aiton, Hort. Kew. edn. 2: 79 [1811]. **Type**: *Without collector & number,* Habitat in Africa, LINN. 310.1 [Holo. Linn. Herb]

Asclepias undulata L., Sp. Pl. edn. 1(1): 214 [1753]. **Type**: As above.

Gomphocarpus undulatus (L.) Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 10 [1894]. **Type:** As above.

**Xysmalobium amplifolium* Weim., in Bot. Notiser: 369 [1935].

Xysmalobium ambiguum N.E. Br., in Fl. Cap. 4(1): 581 [1907]. **Type:** *In Herb Delessert ex Decaisne s.n.,* South Africa, without locality [Holo. *n.v.*].

Xysmalobium angolense* Scott-Elliot, in Journ. Bot. 1890: 365 [1890]. **Type: *Welwitsch 4171,* Huilla, in wet pastures at Catumba not to be confused with Ohai [Syn. *n.v.*]; *Welwitsch 4170,* Huilla and Humpata, frequent in marshy areas next to river [Syn. *n.v.*].

Xysmalobium barbigerum* N.E. Br., in Fl. Trop. Afr. 4(1): 307—308 [1902]. **Type: *Baum 332,* Angola, Amboella, at mouth of the River Kuebem, 1128m [Holo.*n.v.*].

Asclepias ciliata Murray, in Linn. Sys. Veg. edn. 13: 271 [1774]. *Nom. nud.*

Xysmalobium dilatatum* Weim., in Bot. Notiser: 370 [1935]. **Type:

Xysmalobium dispar* N.E. Br., in Fl. Trop. Afr. 4(1): 307 [1902]. **Types: *Ex K. Schulman,* Tanzania, Usseri [Syn. *n.v.*]; *Kirk s.n.,* Malawi, near Sochi Hill, 914m [Syn. *n.v.*]; *Cameron 4,* Malawi, Namasi [Syn. *n.v.*]; *Holub 669,* Zimbabwe, Leshumo Valley [Syn. *n.v.*]. *Holub 816,* Zimbabwe, Leshumo Valley [Syn. *n.v.*].

Apocynum africanum lapathi folio Comm. Hort. Med. Amsteloedam 16 & t16.

Xysmalobium lapathifolim Decne., in DC. Prodr. 8: 519 [1844]. **Type:** *Drège s.n.,* South Africa, Western Cape, Paarlberg & Uitvlugt, 610 to 1219m [Iso. K].

Asclepias leucotricha* Schltr., in Baum, Kunene-Sambesi-Expedition: 342—343 [1903]. **Type: *Baum 332,* Kuebe, auf sandigem, lehmigem Boden, 1150m, 28.10.1899 [*n.v.*].

Xysmalobium leucotrichum* (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 615 [1904]. **Type: As above

**Xysmalobium prismatostigma* K. Schum., in Bot. Jahrb. 17: 120.

Woodia trilobatum* Schltr., in Journ. Bot. 1895: 337 [1895]. **Type: *Elliot 6877,* Nandi (Nile), wet places, 2133—2438m [*n.v.*].

Xysmalobium trilobatum* (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 306 [1902]. **Type: As above.

Gomphocarpus arborescens sensu Sprengel, in Bull. Soc. Tosc. Hort. Ser. 2: 70 & fig. 7, non R. Brown., in Mem. Wern. Soc. 1: 38.

Discussion: For the tropical and west African synonymy (indicated by an *) Bullock (1952) has been followed without question, however, the validity of some of this synonymy needs to be re-examined. Bullock has included species such as *X. angolense* which has, amongst other quite distinct characteristics, the style-apex produced beyond the anthers. *X. dispar* may also deserve varietal or subspecific rank. *X. ambiguum* was described by N.E. Brown based on a description of *X. undulatum* given by Decaisne (1844), however, the description is so ambiguous that the plant could be in one of several genera. To a degree the description of *X. ambiguum* does resemble *X. undulatum* and we have decided to place it in synonymy under this species. Possibly future research could resolve this problem. Wijnands (1983) states that there is no specimen of *X. undulatum* in the Linnaean herbarium and, as a result, selected the Commelin plate (1753) as the type, but this is not correct as the senior author has seen and photographed a perfectly good specimen of this species in the Linnaean herbarium (fig 5). As a result, we have not followed Wijnands' neotypification. In southern Africa, *X. undulatum* can be divided into two varieties (fig. 4)

Xysmalobium undulatum is one of the most widely utilized asclepiad, not only on a local level (the young leaves are eaten as a potherb), but also as one of the major phytomedicines sold in Europe (under the name *uzara*). The copious milky latex is also used in South Africa to treat warts, skin eruptions, wounds and corms, while the silky coma from the seed is used to stuff pillows. A snuff is made from the dried stem-tubers to relieve headaches are also used for a wide range of other complaints from dysentery to colds (Roberts, 1990) (fig. 5).

Distribution: As for the genus.

Conservation Status: Not yet vulnerable or threatened, although populations are begining to decline.

Key to Varieties:

1a Leaves broadly linear, lanceolate, ovate, ovate-lanceolate to elliptic with margins usually undulate; corona-lobes 10 to 13.5mm long; pollinia club-shaped & 1.5 to 2.0mm long ..... var. *undulatum*

1b Leaves narrowly lanceolate to linear with margins not undulate; corona-lobes 6.5 to 8mm long; pollinia bent, pear-shaped & 0.5 to 0.9mm long ..... var. *ensifolium*

1a *Xysmalobium undulatum* (L.) W.T. Aiton variety ***undulatum***

Discussion: This species is extremely variable in its vegetative facie, however, the flowers, in particular the corona and gynostegial-column, are pretty consistent throughout its wide distribution range in southern Africa. Interestingly some specimens collected in the Western Cape province (*Pillans 4168*, *Purcell s.n.* in SAM 90758 and *Purcell 437*) have vegetative features (leaves crowded, trullate or lanceolate-triangular in shape with cordate base and venation below prominent) that resemble *X. stockenstromense* (fig. 4 & 5). *X. undulatum* var. *undulatum* is usually found growing scattered in open grasslands, but can also occur in mass along road side reserves and in farmland that has been left fallow for a number of years. Plants flower between October and May, and occur at altitudes ranging from 84 to 2000 meters. Illustrations of *X. undulatum* var. *undulatum* can be found in Anonymous (1926a), Cribb & Leedal (1982), Wijnands (1983) and Roberts (1990). The illustration in Fox & Young (1982) is not of this species but a of *Pachycarpus* species, probably *P. concolor*.

Distribution: Lesotho, Namibia, South Africa [all provinces] and Swaziland. Also further north in tropical Africa (fig. 3).

Conservation Status: As for the species

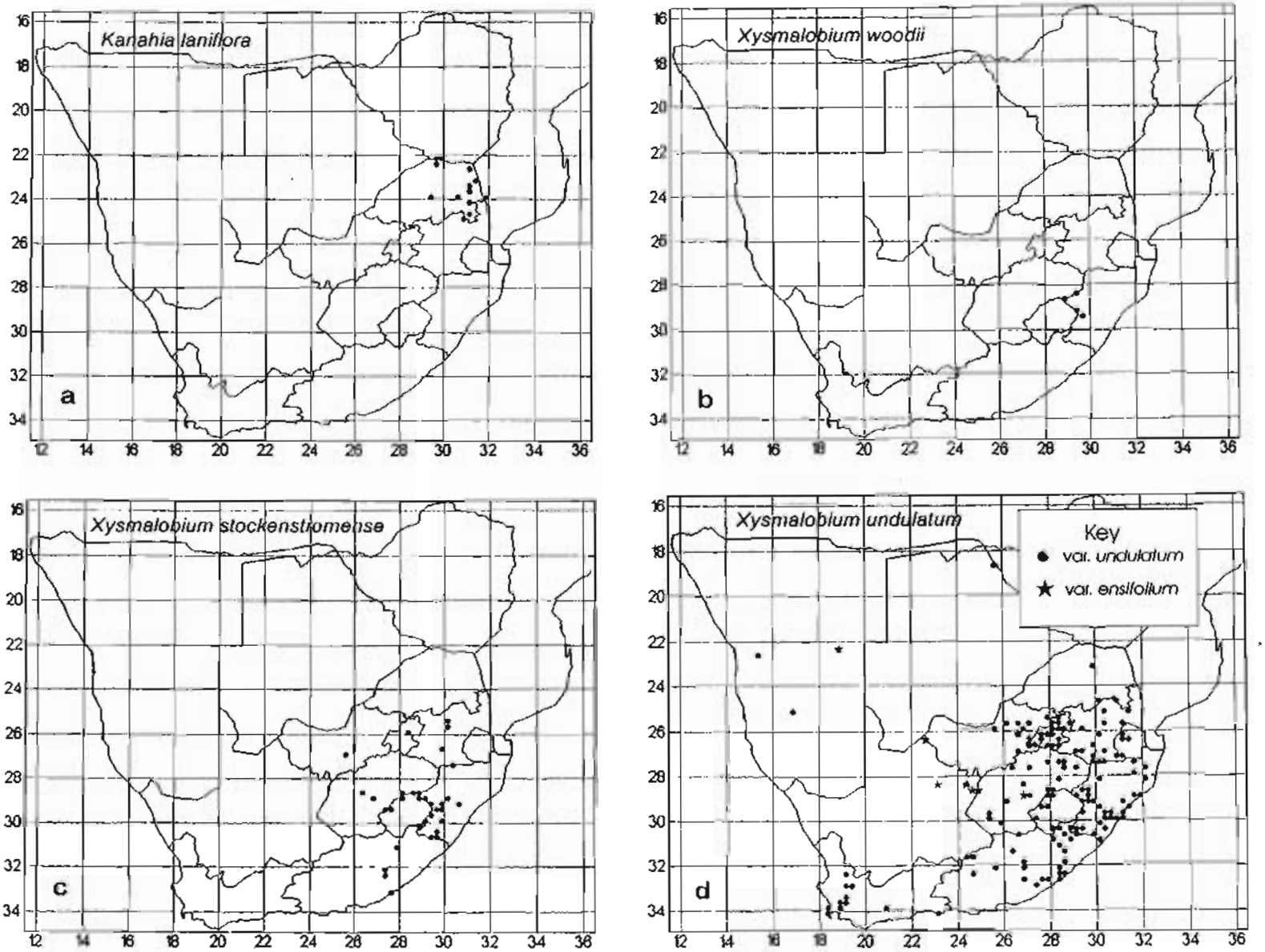

Figure 3. Distribution maps of: a. *Kanahia laniflora*; b. *Xysmalobium woodii*; c. *X. stockenstromense* and; d. *X. undulatum*.

Representative Specimens: Lesotho: *Dieterlen 31*, Likhoele [PRE, SAM]; *Archibald 685*, Tsatsane river valley [GRA]; Watt & *Brandwijk 1919*, Mafeteng district [PRE]; *Ruch 2152*, Roma [PRE]; *Dieterlen 846*, Leribe [PRE]. **Namibia:** *Norle 45*, Grootfontein [PRE]; *Schoenfelder 416*, near Grootfontein [PRE]; *Nagelsbach 13*, between Otavi & Tsumeb [PRE]; *Borle 45*, Gaub, Grootfontein [PRE]. **South Africa:** Northern: *Rogers 18145*, Louis Trichardt [J]; *Breijer s.n.*, Louis Trichardt [PRE 20892] *Burtt Davy 2142*, Springbok Flats [PRE]. North West: *Watt & Brandwyk 1919*, Mafeking [PRE]; *Brink 258*, Potchefstroom Dam [GRA]; *Convent 9*, Klerksdorp [GRA]; *Leendertz s.n.*, Zeerust [PRE 11404]; *Sutton 1216*, Zwartruggens [PRE]. Gauteng: *Moss 9018*, Johannesburg, Melville Koppies Nature Reserve [J]; *Leendertz s.n.*, Pretoria [BLFU 884]; *Werdermann & Oberdieck 1272*, Koedoespoort [PRE]; *Verdoorn 138*, Waterkloof [PRE]; *Smith 1415*, Fountains Station [PRE]; *Retief 59*, Rietvlei [PRE]; *Pole Evans 10117*, Silverton [PRE]; *McMurtry 2855*, Melville Koppies Nature Reserve [PRE]; *Hutchinson 2626*, between Irene & Johannesburg [PRE]. Mpumalanga: *Balsinhas 2973*, Ermelo, Nooitgedacht Research Station [PRE]; *Hepburn 242*, Sterkspruit, Majuba [GRA]; *Devenish 316*, Mooihoek [PRE]; *Galpin 14307*, Bourkes Luck Mine [PRE]; *Jenkins s.n.*, Volksrust [PRE 9299]; *Leendertz s.n.*, Standerton [PRE 11058]; *Leipoldt s.n.*, Piet Retief [PRE 51072]; *Rademacher s.n.*, Carolina [PRE 7462]; *Sidney 3514*, Amersfoort [PRE]; *van Dam s.n.*, Mariepskop [PRE 32965]. Free State: *Nicholas 2780 with DC Nicholas*, between Wepener & Zastron [UDW]; *Fawkes 283*, Strathcona, Ficksburg [NBG]; *Potts s.n.*, Bainsvlei, Bloemfontein [BLFU 1245]; *Coetzee 769*, Lindley, Frankfort [BLFU]; *Potts s.n.*, Dunelm, Fouriesburg [BLFU]; *Potts s.n.*, Trompsburg [BLFU 7536]; *J & B Potgieter s.n.*, Bethlehem area [BLFU]; *du Preez 1300*, Korannaberg [BLFU]; *Pont 623*, Pumping Station, Kroonstad district [PRE]; *Retief 1025*, Susannaskop [PRE]; *Retief 1926*, Langverwag farm, near Vrede [PRE]. KwaZulu-Natal: *Nicholas 1010*, between Ixopo & Richmond [CPF]; *Nicholas 1031*, near Midmar Dam [CPF, K]; *Venter 3069*, between Mtunzini & Nagoya Forest [BLFU]; *Nicholas 2710 with Poorun*, Westville,

Figure 4. *Xysmalobium undulatum*: a. & b. Whole plant showing habit & habitat (*circa* 1 meter tall); c. Inflorescence, d. Close up of flowers and; e. Plant with follicles. Photographs: a to c by A. Nicholas; d by T. Coleman and; e. by P. Cooke.

Durban [UDW]; *Nicholas 2712 with Kasavan*, Verulam [UDW]; *Nicholas 2727*, between Midmar & Bulwer [UDW]; *Goodman 1220*, Mkuzi Game Reserve [Mkuzi]; *Ward 1897*, Hluhluwe Game Reserve [PRE]; *Trauseld 312*, Giant's Castle Game Reserve [PRE]; *Ward 1204*, Tembe Elephant Park [NH]; *Schrire 893*, near Highflats [NH]; *Strey 6152*, Izingolweni [PRE]; *Shepard 49*, Uithoek farm, Glencoe district [PRE]; *Mogg 3471*, Tweedie [PRE]; *MacDevette 1507*, Umkomaas Vallet [PRE]; *Ward 589*, Amatikulu Nature Reserve [NH]; *Jordaan 2098*, Itala Nature Reserve [NH]; *Dyer & Verdoorn 2373*, between Inchanga & Pietermaritzburg [PRE]; *Codd 2425*, Blesboklaagte, Dundee district [PRE]. Eastern Cape: *Nicholas 2830 with DC. Nicholas*, between Komga & King William's Town [UDW]; *Cloete 2241*, Mzamba River estuary [NH]; *Strey 10810*, Mt Frere-Cedarville [NH]; *Phillipson 1195*, Menziesberg [UFH]; *Hilner 26*, Matatiele [GRA]; *Fourcade 1543*, Ruiqte Vlei, Zwart River [GRA]; *Ndzamela 8*, Tsolo [GRA]; *Dole 1336*, Woodcliffe Farm, Maclear district [GRA]; *Flanagan756*, near Komga [GRA]; *Galpin 1916*, Queenstown [GRA]; *Sister Stephany 22*, Mount Currie [GRA]; *Dold 1913 with Cocks*, Beeachamwood, Gatyana [GRA]; *MacOwen 404*, Boschberg near Somerset East [GRA]; *Acocks 20119*, Zuurfontein [PRE]; *Brusse 5095*, Weltevrede farm, near Kokstad [PRE]; *Pegler 691A*, Kentani district [PRE]; *Strever 545*, York farm, Ongeluksnek [PRE]; *Strey 10810*, Mount Frere-Cedarville [PRE]; *van Breda 879*, Collywobbles [PRE]. Northern Cape: *Hanekom 1941*, Roelofsfontein [PRE]; *Marloth 5355*, Richmond [PRE]. Western Cape: *Poppe s.n.*, Cape Peninsula, Houtbay [SAM]; *Purcell 437*, Bergvliet farm, Constantia [SAM]; *Purcell s.n.*, Bergvliet farm, Constantia [SAM 90758]; *Pillans 4168*, Karbonkel, Cape Peninsula [PRE]; *Hanekom 2571*, Ondertuin, Koue Bokkeveld [PRE]; Marloth 1655, Theron's farm, Tulbagh [PRE]; Marloth 10022, Stellenbosch [PRE]. **Swaziland:** *Compton 26516*, near Forbes Reef, Mbabane [NBG]; *Dlamini s.n.*, Nkomosane river [PRE 31160]; *Werdermann & Oberdieck 2203*, between Piggs Peak & Mbabane [PRE]; *Burtt Davy 2926*, between Bremmersdorp & McNabs [PRE]; *Compton 27370*, Malkerns [PRE].

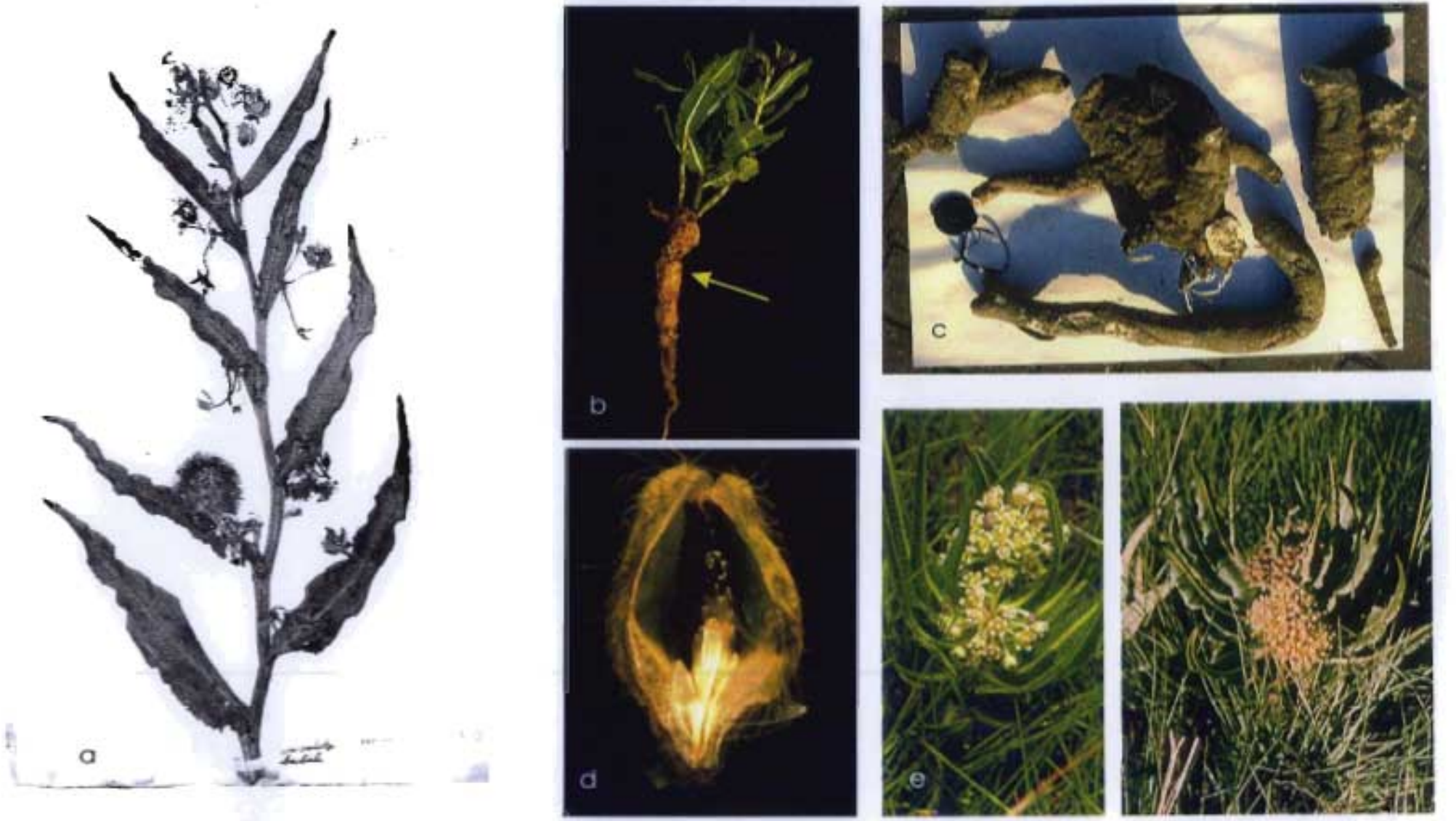

Figure 5. *Xysmalobium undulatum*: a. Holotype LINN. 310.1 (housed at the Linnean Herbarium), note the alternate leaves & flexuose stem which are not common features in this species; b. Young plant showing stem-tuber, indicated with an arrow; c. Stem-tubers of mature plants, note the irregular structure & corky fissured surface. These tubers are widely used in traditional medicine in southern Africa & also sold in herbal shops in Europe under the name Uzura; d. Mature dehisced follicle showing seeds with silky coma. *X. stockenstroomense*: e. & f. Whole plant showing habit (*circa* 350mm tall). Photographs: a to d & f by A. Nicholas and; e by M. von. Fintel.

1b *Xysmalobium undulatum* variety ***ensifolium*** Burch. ex Scott-Elliot, in Journ. Bot. 28: 364 [1890]. **Type**: *Burchell 1834,* South Africa, North West province, Herbert Division, Upper Cambell (Spring), Grootfontein, 18th Nov. 1811 [Lecto., chosen here, K]. *Burchell 2491*, Botswana, Klibbolikhonni Spruit, near Litakun [Syn. *n.v.*].

Xysmalobium ensifolium (Burch. ex Scott-Elliot) N.E. Br., in Fl. Cap. 4(1): 571 [1907]. **Type**: As above.

Discussion: Because variety *undulatum* is so variable it is hard to justify keeping *ensifolium* as distinct. However, as Langley (1980) also points out, the narrowly lanceolate leaves without undulate margins, smaller flowers with differently shaped and smaller pollinia, when combined with its isolated distribution on the periphery of the range of the type variety, makes it a distinct ecotype worthy of recognition at the varietal level. We have also noted that the fruits are generally narrowly oblong and slightly curved, instead of ovoid This taxon is found growing in sandy soils in grasslands and flowers between December and April. It occurs in the drier part of the species distribution range at altitudes of between about 1000 and 1300 meters.

Distribution: Southern African endemic. Botswana, Namibia and South Africa [North West & Free State provinces] (fig. 3).

Conservation status: Low Risk (Least Concern). Vulnerable.

Representative Specimens: Botswana: *Marloth 1012*, Near Grootkuil [PRE]; *Smith 4302*, Sibuyu [PRE]. **Namibia:** *Wilman 27131*, Gobabis [SAM]. **South Africa:** North West: *Louw 641*, Boskop [PRE]; *Theron 1170*, Klipdrift [PRE]; *Ubbink 1199*, Katdoringbos farm, near Rysmierbultburg [PRE]. Free State: *Acocks 21006*, near Verkeerdoola, Brandfort district [PRE]. Northern Cape: *Patton s.n.*, Newlands, Barkley West [PRE 51106]; *Hutchinson 3022,* near Blinkklip, Postmasburg [K]; *Wilman 26933,* Zoutpan [SAM]. Eastern Cape: *Galpin 1916*, Bongolo Poort

Excluded Southern African Names:

X. acerateoides N.E. Br. = ***Pachyacris acerateoides*** **(N.E. Br.) Stewart & Langley ex Nicholas & Goyder** (in press)

X. albens (E. Mey.) Dietr. = ***Pachyacris albens*** **(E. Mey.) Nicholas & Goyder** (in press).

X. ambiguum N.E. Br. = ***Xysmalobium undulatum*** **(L.) W. T. Aiton**

X. appendiculatum (E. Mey.) Dietr. = ***Pachycarpus appendiculatus*** **E. Mey.**

X. asperum N.E. Br. = ***Pachyacris sulphurea*** **(N.B. Br.) Nicholas & Goyder** (in press)

X. baurii N.E. Br. = ***Pachyacris baurii*** **(N.E. Br.) Stewart & Langley ex Nicholas & Goyder** (in press)

X. brownianum S. Moore = ***Woodia brownianum*** **(S. Moore) Nicholas**

X. carinatum (Schltr.) N.E. Br. = ***Stenostelma carinatum*** **(Schltr.) Bullock**

X. concolor (E. Mey.) Dietr. = ***Pachycarpus concolor*** **E. Mey.**

X. confusum Scott-Elliot = ***Pachycarpus confusum*** **(Scott-Elliot) Nicholas**

X. coronarium (E. Mey.) Dietr. = ***Pachycarpus coronarius*** **E. Mey.**

X. crispum (Berg.) Dietr. = ***Pachyacris crispa*** **(Berg.) Nicholas & Goyder** (in press)

X. dealbatum (E. Mey.) Dietr. = ***Pachycarpus dealbatus*** **E. Mey.**

X. ensifolium Burch. ex Scott-Elliot = ***Xysmalobium undulatum*** **(L.) W.T. Aiton var. *ensifolium* Burch. ex Scott-Elliot**

X. fluviale Bruyns = ***Woodia fluviale*** **(Bruyns) Nicholas**

X. gerrardii Scott-Elliot = ***Pachyacris gerrardii*** **(Scott-Elliot) Stewart & Langley ex Nicholas & Goyder**

X. gomphocarpoides (E. Mey.) Decne. = ***Woodia gomphocarpoides*** **(E. Mey.) Nicholas**

X. gomphocarpoides (E. Mey.) Decne. var. *parvilobium* Bruyns = ***Woodia parviloba*** **(Bruyns) Nicholas**

X. grandiflorum (L.f.) R. Br. = ***Pachycarpus grandiflorus*** **(L.f.) E. Mey.**

X. humile (E. Mey.) Dietr. = ***Aidomene humilis*** **(E. Mey.) Nicholas & Goyder**

X. involucratum (E. Mey.) Decne. = ***Stenostelma involucratum*** **(Decne.) Nicholas**

X. lapathifolium Decne. = ***Xysmalobium undulatum* (L.) W.T. Aiton var. *undulatum***

X. ligulatum Dietr. = ***Pachycarpus dealbatus* E. Mey.**

X. linguaeforme Weale = ***Woodia mucronata* (Thunb.) N.E. Br.**

X. marginatum (E. Mey.) Dietr. = ***Woodia mucronata* (Thunb.) N.E. Br.**

X. orbiculare (E. Mey.) Dietr. = ***Pachycarpus orbicularis* E. Mey.**

X. padifolium (Baker) Scott-Elliot = ***Pachycarpus orbicularis* E. Mey.**

X. parviflorum Harv. ex Scott-Elliot = ***Pachyacris parviflora* (Harv. ex Scott-Elliot) Stewart & Langley ex Nicholas & Goyder**

X. pearsonii L. Bolus = ***Woodia pearsonii* (L. Bolus) Nicholas**

X. pendunculatum Harv. = ***Pachyacris prunelloides* (Turcz.) Stewart & Langley ex Nicholas & Goyder**

X. prunelloides Turcz. = ***Pachyacris prunelloides* (Turcz.) Stewart & Langley ex Nicholas & Goyder**

X. reflectens (E. Mey.) Dietr. = ***Pachycarpus reflectens* E. Mey.**

X. rigidum (E. Mey.) Dietr. = ***Pachycarpus rigidus* E. Mey.**

X. trauseldii = ***Xysmalobium woodii* N.E. Br.**

X. tysonianum N.E. Br. = ***Pachyacris tysoniana* (N.E. Br.) Nicholas & Goyder** (in press)

X. vexillare (E. Mey.) Dietr. = ***Pachycarpus vexillaris* E. Mey.**

X. viridiflorus (E. Mey.) Dietr. = ***Tomoloma viridiflora* (E. Mey.) Nicholas & Goyder** (in press)

X. winterbergense N.E. Br. = ***Woodia winterbergense* (N.E. Br.) Nicholas**

X. zeyheri N.E. Br. = ***Woodia zeyheri* (N.E. Br.) Nicholas**

PACHYCARPUS E. Mey., Comm. Pl. Afr. Aust.: 209 [1838]. **Type species:** *Pachycarpus grandiflorus* (L.f.) E. Mey. (Basionym = *Asclepias grandiflorus* L.f.). Lectotypified by Phillips (1951: 602).

Gomphocarpus sect. *Pachycarpus* (E. Mey.) Decne., in DC. Prodr. 8: 562 [1844].

Type species: As above.

Description: *Habit:* Perennial, geophytic herbs, sometimes almost shrubby; with milky latex. *Underground organ* a turnip-shaped or very deep-seated narrowly cylindrical fleshy stem-tuber or shallow horizontal fleshy & fusiform (fig. 10 & 18). *Stems* 1—3(-5), simple or branched, erect or decumbent, slender to stout, 140—1300mm tall, 8—11mm wide, usually produced annually. *Leaves* opposite, usually decussate, spreading to spreading erect, rarely crowded towards the base, longer than the internodes, subsessile to petiolate; lamina coriaceous, usually broad but sometimes narrow, narrow-lanceolate, lanceolate, ovate, elliptic, broadly elliptic to orbicular, rarely obovate or linear, 25—150mm long, 4—70mm wide, apex pointed, acute, obtuse to rounded, sometimes emarginate &/or mucronate, base cuneate, rounded or broadly subcordate, margins entire, undulate or flat, venation sometimes prominent, glabrous, glabrate, scabrous, hispid or harshly pubescent; petiole stout, usually flattened or shallowly chaneled down the upper surface, sometimes winged, 1—15mm long. *Inflorescences* up to 16 per plant, rarely 1, lax or crowded, usually racemosely arrange on the stem, rarely corymbose, sessile, subsessile or pedunculate, erect, never pendulous, lateral at the node & terminal, produced extra-axillary, umbelliform, globose, hemispherical or irregular (1-)2—18-(-48)-flowered; peduncles sessile or up to 90mm long & often stout; bracts (0.5-)2.0—32.0mm long, narrowly linear, linear, narrowly lanceolate, ovate to narrowly elliptic, apex pointed to acute, glabrous above, pubescent to scabrous below, often caducous. *Flowers* globose-campanulate, cupulate or reflexed, often very large, white, green, green & purple, purple, red, yellow, gray, brownish or a combination of these, often with purple or dark spots; puberulous, pubescent, subtomentose to tomentose; pedicels 8—25mm

long, slender to stout. *Calyx* 5-merous, usually with many ovate-elliptic or oblong septal glands at the base; lobes linear, lanceolate, ovate, elliptic to suborbicular, 3—27mm long, 1.0—9.2mm wide, glabrous above, thinly to densely pubescent below. *Corolla* 8—46mm, rotate, catilliform or reflexed, divided almost to base, rarely campanulate then with petals fused for 1/2 to 2/3 of their length, 5-merous; tube short & disc-like, rarely campanulate & almost globose; lobes erect, spreading or reflexed, without a corolline corona, lanceolate, narrowly ovate, ovate, elliptic-oblong, oblong-ovate, elliptic to suborbicular, 5.5—31.0mm long, 3—17mm wide, apex acute, entire or with a small symmetrical or oblique notch, margins revolute. *Staminal-corona* in 1-series, 5-merous, arising at the base of the gynostegial-column or up to 3mm above the base, rarely produced near the top of the column, quite free or closely appressed to the gynostegial-column; lobes erect or spreading horizontally, sometimes with the apex erect or even inflexed, dorso-ventrally flattened, slipper-shaped, rarely cucullate or saccate, seldom obovate to suborbicular & scale-like flat & fleshy, 1.5—36.0mm long, 1—9mm wide, with or without various types of flaps, keels, wings or small appendages on the upper or inner surface, these if present 0.5—31.0mm long, 0.6—7.0mm tall, lobes spreading horizontal from the base, upper portion obtuse, tail-like, tongue-like or rarely absent, if prominent then spreading, erect or inflexed, with the apex pointed, obtuse, entire or sometimes 3-lobed, below, level with or exceeding the style-apex, white, purple, brown, yellow or red. *Staminal-column* 2—11mm tall, stout, often conical, usually constricted under the anther-wings. *Anthers:* anther-wings 0.9—8.6mm long, large, horny & with margin vertical or oblique, straight edged or concave, basal margin concave & angled; anther-appendages sometimes large, broadly ovate, oblong, elliptic, ovate-elliptic, orbicular, suborbicular or subreniform, 1.0—4.8mm long, white, membranous, exceeding & connivent over the style-apex or erect on the sides of the style-stigma-head. *Pollinaria*: Pollinia solitary, pendulous, obovate, subdeltoid or narrowly kidney-shaped, base rounded to obtuse-oblong, attached apically in pairs via stout, usually geniculate

translator-arms to a corpusculum; corpusculum large, oval, with or without lateral membranous wings. *Style-apex* truncate, sometimes cushion-shaped, with depressed in the centre with margins crenate, rarely produced to 2.5mm above the anthers. *Follicles* erect, usually solitary, ovoid to globose, 30—135mm long, 12—58mm wide, semi- to fully inflated, glabrous, thick skinned & leathery, with or without 6, rarely 7, longitudinal wings, ridges or occasionally rows of teeth, rarely bearing short stout recurved spines, apex round or obtusely pointed; borned on recurved fruiting pedicel. *Chemistry*: Defensins include cardenolides, strophanthidin, anhydroperiplogenone & cymarin. *Etymology:* From the Greek: *pachy* (= thick) and *carpus* (= fruit), in reference to the thick fruit pericarp.

Discussion: This genus has had a chequered history. E. Meyer (1838) who proposed the genus characterised it using habit, pollinarium shape and, in particular, fruit structure. Unfortunately he included species that didn't really belong together; only nine of the 16 placed there by him still remain in the genus. It was because of this that it was not recognized by Bentham & Hooker (1876). Dietrich (1840) and Schlechter (1896) treated it as a synonym (without rank) under *Xysmalobium* and *Asclepias* respectively. Harvey (1868) seems to have been the only author to continue to recognise the genus as defined by Meyer. Decaisne (1844), however, recognized it as a section under *Gomphocarpus*, but redefined it using the distinctive nature or the corolla and corona as found in southern African species. Schumann (1895) followed Decaisne in treating it as a section of *Gomphocarpus*, but begun to include species not clearly allied to the taxa placed there by Decaisne. N.E. Brown (1902 & 1908), more or less, reverted back to Decaisne's circumscription, but more clearly defined the genus using the common possession of the following character: Sessile stout truncated cone-like gynostegial-column, broad ridged anther-wings, corona-lobe structure and large leathery usually winged fruits. He, correctly, felt that these where distinct and important enough to warrant raising *Pachycarpus* back to generic status. He also added a number of, mainly new, species to it.

His work resulted in a genus in which the species seemed to be more clearly related. The genus as envisioned by N.E. Brown still holds true even though it has been expanded from the original 16 species to a genus of some 33 species. Southern African species were revised by Smith (1980 & 1988) and the tropical African species by Bullock (1954) and Goyder (1998). These works should be consulted for a more complete understanding of the history of the genus and its classification.

The genus was divided into two sections (*Pachycarpus* & *Trichocodon*) by Smith (1980 & 1988) during her thorough revision of the genus in southern Africa. Unfortunately, the sectional name *Campanulati* was first used (for what is now *Trichocodon*) by Schlechter (1896) when it was still included by him under *Gomphocarpus* and, thus, needed to take priority. Smith based the division of the genus on differences in leaf and inflorescence morphology, flower orientation and presence or absence of hairs on the carpels. Besides these differences the corona of this group appears to be more closely related to *Aidomene* and *Fanninia*, and the stem-tuber is also quite different. As a result we have not followed this division but rather decided to raise section *Campanulati* to generic status. For more detailed reasons behind our decision see under the genus *Trichocodon* later in this paper.

Langley (1980) noted the fact that *Xysmalobium orbiculare* and *X. confusa* did not belong in this genus, but were more clearly allied to *Parapodium*. To express this close affinity, he and Stewart proposed placing these two species in the new genus *Parapodiopsis*; the genus was, unfortunately, never validly or effectively published. During our study of the subtribe Asclepiadinae, however, we have found that these two species are more nearly related to *Pachycarpus galpinii*. They can only be distinguished from this species by their different corona-lobe; which is more blob-like (a feature which they have in common with *Xysmalobium* as defined in this paper) than tongue- or slipper-like. We have, as a result, decided to place *X. orbiculare* and *X. confusa* in a new subgenus, *Parapodiopsis*, under *Pachycarpus*.

Pachycarpus, to some extent, resembles *Xysmalobium* and probably had a common origin with it. It also resembles *Parapodium*, but this latter genus may have arisen from *Pachycarpus* subgenus *Parapodiopsis*. Kunze (1997) has reported vestigial interstaminal corona lobes in *Xysmalobium*, *Pachycarpus* and *Parapodium*. This may be a fairly widespread phenomenon in the subtribe Asclepiadinae. These structures are very small, and usually obscured by the anther-wings and sometimes even the staminal corona-lobes (terminology following Kunze). As a result, they are often over looked (Bruyns 1995 & Goyder 1998) and generally of little major diagnostic importance. In fact, they are so small, in most cases being almost obsolete, that to call them "lobes" is quite misleading.

Pachycarpus as defined here can be distinguished by its stout stems with large pith (this usually disintergrating in pressed specimens leaving the stem hollow), broad leaves, inflorescences lateral at the nodes, peduncles stout, flowers erect and carpels smooth. There are 20 species in southern Africa. Plants are usually found in grasslands, especially if burned annually, or open woodlands. Species are found south of the Sahara and are particularly abundant down the eastern half of the continent from Kenya to South Africa. Although also occuring, less commonly, in West Africa and down the western half as far as northern Namibia. One or two *Pachycarpus* species are also weedy. These are commonly found along road sides and in disturbed areas.

Smith's 1988 revision deals basically with the taxonomy and nomenclature of the genus in southern Africa, however, this work was based on an earlier M.Sc. thesis (1980) which is much more comprehensive and covers aspects of seedling development, anatomy, microcharacters and floral and pollination biology. Those interested in the genus need to consult this earlier work. We have largely agreed with her findings, but have found it necessary to describe a new variety under *P. dealbatus* and to raise section *Campanulati* to generic status under the name *Trichocodon*. Goyder (1998) during his treament of *Pachycarpus* in tropical Africa sunk *P. transvaalensis* and *P. decorus* under

P. concolor. However, we believe these to represent distinct genetic phenomena worthy of recogniztion and, thus, conservation. By sinking them under *P. concolor* (to which they are clearly related) this pattern is lost and these special genotypes are no longer seen as worthy of conservation and may, as a result, be condemed to extinction. Because of this, we have decided to treat *P. transvaalensis* as a subspecies under *P. concolor*. *P. decorus*, which may have a different pollination syndrome, is maintained as a distinct species. We discuss our reasoning futher under these species. In most other works the appendages on the upper surface of the basal horizonal portion of the corona-lobes have been called keels. We have, however, chosen to call these structures wings. They act as rails that guide the pollinating insects legs to the bottom of the gynostegial-groove.

Distribution: African endemic. Occuring in Africa south of the Sahara. Absent from Madagascar. Southern Africa in Botswana, Namibia, Lesotho, South Africa [all provinces] and Swaziland.

PACHYCARPUS* E. Mey. Subgenus *PACHYCARPUS

Description: *Habit:* herbs, sometimes almost shrubby. *Underground organ* a very deep-seated narrowly cylindrical fleshy stem-tuber or shallow horizontal fleshy & fusiform. *Stems* 1—3(-5), simple or branched, erect or decumbent, slender to robust, 140—1060mm tall. *Leaves* petiolate; lamina usually broad but sometimes narrow, 25—150mm long, 4—70mm wide, narrow-lanceolate, ovate, elliptic to orbicular, rarely linear, apex pointed, acute, obtuse to rounded, base cuneate to rounded, margins undulate or flat; petiolate usually flattened or shallowly chaneled down the upper surface, sometimes winged, 1—15mm long. *Inflorescences* usually several per plant, rarely 1, sessile, subsessile or pedunculate, (1-)2—18-flowered; peduncles sessile or up to 90mm long; bracts (0.5-)2.0—22.5mm long, narrowly linear, linear, narrowly lanceolate, ovate to narrowly elliptic, apex pointed to acute, glabrous above, pubescent to scabrous below,

often caducous. *Flowers* often very large, usually more than 15mm, white, green, green & purple, purple, red, yellow, gray, often with purple or dark spots; puberulous, pubescent, subtomentose to tomentose. *Calyx lobes* 4.5—27.0mm long, 1.8—9.2mm wide, linear, lanceolate, elliptic to suborbicular, glabrous above, thinly to densely pubescent below. *Corolla* 10—46mm, rotate, catilliform or reflexed, divided almost to base, rarely campanulate then with petals fused for 1/2 to 2/3 of their length, tube short & disc-like, rarely campanulate & almost globose; lobes 5.8—31.0mm long, 3.2—17.0mm wide, lanceolate, ovate, elliptic-oblong, elliptic to suborbicular, erect, spreading or reflexed. *Staminal-corona* arising at the base of the gynostegial-column or up to 3mm above the base; lobes dorso-ventrally flattened, slipper-shaped, (2-)5—36mm long, 1—9mm wide, with or without various types of flaps, keels, wings or small appendages on the upper surface, these if present 0.5—31.0mm long, 0.6—7.0mm tall, lobes spreading horizontal from the base, sometimes with the upper portion erect or inflexed, apex entire or sometimes 3-lobed. *Staminal-column* 2—11mm tall, stout, often conical. *Anthers:* anther-wings 0.9—8.6mm long, large, horny & with outer margin vertical or oblique, straight edged or concave, basal margin concave & angled; anther-appendages sometimes large, 1.0—4.8mm long, broadly ovate, oblong, elliptic to orbicular & sometimes cordate, exceeding & connivent over the style-apex. *Pollinaria*: Pollinia obovate to subdeltoid. *Style-apex* truncated & depressed in the centre with margins crenate, rarely produced to 2.5mm above the anthers. *Follicles* usually solitary, ovoid to globose, 50—135mm long, 20—58mm wide, semi- to fully inflated, glabrous, thick skinned, with or without 6, rarely 7, longitudinal wings, ridges or occasionally rows of teeth. *Chemistry*: Defensins include cardenolides, strophanthidin, anhydroperiplogenone & cymarin. *Etymology:* From the Greek: *pachy* (= thick) and *carpus* (= fruit), in reference to the thick fruit pericarp.

Discussion: Based on an assessment of their overall morphology, we have tried to put the southern African species of this subgenus in some phylogenetic order. As this arrangement differs from all previous authors we feel it best to give our reasoning below:

Group 1: *P. galpinii*, *P. dealbatus*, *P. lebombonenis*, *P. schinzianus*, *P. rigidus* and *P. stenoglossus* all have corona-lobes that are more or less featureless and globose corollas in which the petals are erect, reflexed at the tip, and free almost to the base. In this, and in their vegetative facie, they are similar to *Xysmalobium* and *Pachycarpus* subgenus *Parapodiopsis*. In fact, *P. schinzianus* has leaves that are extremely reminiscent of *X. stockenstromense*. We have called this group of species the basal group because of these similarities to *Xysmalobium*. In this species assemblage can be seen the beginnings of corona-lobe ornamentation: *P. schinzianus* has two basal teeth and *P. stenoglossus* has two small basal and somewhat rectangular keel wings.

Most non-basal species show different degrees of ornamentation and in the case of *P. asperifolius* reduction of the corona-lobe. Various distinct groups can be defined based on evolutionary trends seen within the corolla and corona. Most of these other groups can, however, be derived from the simple structures seen in the basal group, especially that exhibited by *P. stenoglossus*.

Group 2: *P. mackenii*, *P. grandiflorus* and *P. coronarius* have ornamented corona-lobes (consisting of simple erect adaxial wings and simple apex) and globose corollas that tend to hide the gynostegial-column. *P. grandiflorus* has a corona-lobe similar to *P. stenoglossus* showing a link to the basal group.

Group 3: *P. concolor* (in which we have included *P. transvaalensis* as a subspecies), *P. decorus* and *P. lineolatus* form a group with ornamented, swollen, slipper-shaped corona-lobes (consisting of simple erect swollen adaxial wings and simple apex)

and a shallow, cup-like or catilliform corolla. This group of taxa have some similarity with *P. stenoglossus* in the basal group.

Group 4: *P. vexillaris*, *P. macrochilus*, *P. plicatus*, *P. natalensis*, *P. reflectens*, *P. appendiculatus* and *P. scaber* have ornamented corona-lobes with the adaxial surface bearing simple or complex, erect or laterally spreading ridge-like, fin-like or strongly reflexed wings. In these corona-lobes the apex also becomes progressively inflexed expanded and leaf-like, forming a loose cage-like covering over the style-apex, sometimes the lobe tip can become trifid or cruciform. *P. appendiculatus* has a very ornate corona-lobe. The corolla in this group varies from campanulate (*P. vexillaris* & *P. macrochilus*) to cupulate (*P. plicatus*) to catilliform or saucer-like (*P. natalensis*) to reflexed (*P. appendiculatus* & *P. scaber*) to defexed (*P. reflectens*). *P. stenoglossus* tends to fall somewhat between the basal stem group and this group. *P. scaber* is unusual because although it has a corona-lobe shape that places it in this group its white flowers are unusual. *P. scaber* and *P. appendiculatus* have globose inflated (semi inflated in the case of *P. appendiculatus*) fruit with a thick, smooth leathery ectocarp, this type of fruit is similar to those found in *Pachycarpus confusus* of subgenus *Parapodiopsis*, *Xysmalobium* and *Calotropis*.

Group 5: *P. asperifolius* is unusual amongst the subgenus *Pachycarpus* in having reduced corona-lobes (small and blob-like, and composed entirely of swollen contiguous wings on the adaxial surface) with the tip absent or small and tail-like. The corolla is reflexed. The fruits are similar to those of *P. scaber* in group 4 and *P. lineolatus* in group 3. Such globosely inflated fruits are also found in *P. bisacculatus*, a tropical African species (Goyder 1998).

These groups are informal and must be considered speculative, they form a hypothesis that can be tested empirically when cladistics and DNA sequence data can be brought to bear on this genus. Also, they are based on patterns seen in southern African species and may not work in tropical Africa.

Distribution: African endemic. Found in grasslands south of the Sahara, but absent from desert & winter rainfall regions.

Key to Species:

1b. Corona reflexed 2

1a Corolla globose-campanulate or spreading & cup-like 5

2a. Flowers white ..... *P. scaber*

2b. Flowers any color but white 3

3a. Apical half of the corona not dilated & leaf-like, sometimes even absent ..... *P. asperifolius*

3b. Apical half of corona dilated & leaf-like 4

4a. Corolla reflexed to touch the pedicel ..... *P. reflectens*

4b. Corolla spreading reflexed, but not touching the pedicel ..... *P. appendiculatus*

5a. Flowers pure white, cream or creamy yellow 6

5a. Flowers usually any color but white, cream or creamy yellow if whitish then marked with purple 7

6a. Corona-lobes ligulate, the horizontal part short (3 to 5mm) with 2 short teeth, the upper erect part long (6 to 10mm) & dilated apically ..... *P. schinzianus*

6b. Corona-lobes slipper-like, the horizontal part long (4 to 7mm), swollen with 2 large quadrate wings, the upper erect part short (2 to 4mm) & tapering ..... *P. decorus*

7a Apical portion of corona-lobe dilated & leaf-like 8

7b. Apical portion of corona not dilated & leaf-like 11

8a. Horizontal basal portion of corona-lobe narrow & simple, without wings or teeth ..... *P. rigidus*

8b. Horizontal portion of corona-lobe narrow or broad & with wings or teeth 9

9a. Corolla cup-like with gynostegial-column completely exposed ..... *P. natalensis*

9b. Corolla campanulate with gynostegial-column more or less completely enclosed 10

10a. Basal horizontal portion of corona-lobe narrow through-out ..... *P. macrochilus*

10b. Basal horizontal portion of corona-lobe dilated into lateral auricles ..... *P. plicatus*

11a. Corona-lobes completely simple through-out, without wings or teeth 12

11a. Corona-lobes not simple, with wings or teeth, even if these are very small or swollen & fleshy 13

12a. Erect portion of corona-lobe linear & not dilated ..... *P. lebomboensis*

12b. Erect portion of corona-lobe ligulate & slightly dilated ..... *P. dealbatus*

13a. Basal horizontal portion of the corona-lobe with long or small teeth 14

13b. Basal horizontal portion of the corona-lobe with large or small quadrate wings these sometimes swollen & fleshy 16

14a. Teeth on horizontal portion of the corona-lobe large, falcate & reflexed to touch or by-pass the erect portion ..... *P. vexillaris.*

14b. Teeth on horizontal portion of the corona-lobe very small, never reflexed to touch the erect portion 15

15a. Margins of corona-lobes reflexed so that they form a channel down the back ..... *P. galpinii*

15b. Margins of corona-lobes not reflexed but flat so they are not chaneled down the back ..... *P. lebomboensis*

16a. Corolla 30 to 46mm long 17

16b. Corolla 10 to 25mm long 18

17a. Corolla more or less lobed to the base ..... *P. coronarius*

17b. Corolla lobed for 1/2 to 2/3 of their length ..... *P. grandiflorus*

18a. Corona-lobes winged for more than half of its length these sometimes

fleshy & swollen 19

18b. Corona-lobes winged for less than half of its length these never fleshy & swollen ..... *P. stenoglossus*

19a. Corolla cup-like with the gynostegial-column exposed 20

19b. Corolla campanulate with gynostegial-column mostly hidden ..... *P. mackenii*

20a. Flowers purple or yellow; inflorescences 1 to 5, but usually 2-flowered; peduncles sessile or up to 60mm long ..... *P. concolor*

20b. Flowers white marked purple; inflorescences 4 to 12-flowered, never 2-flowered; peduncles 30 to 140mm long ..... *P. lineolatus*

1. ***Pachycarpus galpinii*** (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 377 [1902]. **Type**: *Galpin 692a.* South Africa, Mpumalanga, Barberton, Saddleback, on mountain sides, 1370m [Holo. B† Iso. PRE]

Gomphocarpus galpinii Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 18 [1894]. **Type:** As above.

Asclepias galpinii (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As above.

Discussion: This species resembles *P. dealbatus*. Differences between the two species are discussed under this species. Although linear, like many species of group 1, the corona-lobe is unique in the genus in having the margins reflexed thus presenting the inner-face which appears as a thickened keel and turns the outer-face into a channel. Laterally at the very base are two small teeth while the apex greatly exceeds the style-head, in this latter character it is similar to *P. lebomboensis*. This species, in its corona-lobes and flower structure, resembles species in *Pachycarpus* subgenus *Parapodiopsis*, as well as the

genera *Parapodium* and *Xysmalobium*. Flowering occurs from October to December and plants can be found at altitudes of between 1220 and 1800 meters. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. South Africa [Mpumalanga Province only] and Swaziland (fig. 7)

Conservation Status: Low Risk (Near Threatened). This species is known from only a handful of specimens and obviously of limited distribution. It also occurs in an area that is rapidly being destroyed by aforestation (mainly pine & eucalyptus), and must be considered at risk. Many populations probably endangered.

Representative Specimens: South Africa: Mpumalanga: *Thorncroft 1107,* Lomati Valley, Barberton [PRE]; *de Souza 591*, Ameida farm, near Barberton [PRE]; *Germishuizen 5708*, Songimvelo Game Reserve, Kangwane [PRE]; *Kluge 2087*, Morgenzon nature Reserve [PRE]; *Louw 2368*, Lisbon falls [PRE]; *Venter 12593*, Paradise Camp, Graskop [PRE]. **Swaziland:** *Compton 32451*, Forbes Reef [PRE]; *Dlamini s.n.*, Dalriach [PRE 31190]; *Compton 31189*, Mbolaleni [PRE]; *Kemp 1135*, near Mbabane [PRE].

2. *Pachycarpus dealbatus* E. Mey., Comm. Pl. Afr. Aust.: 211 [1838]. **Types**: *Drège 1837,* South Africa, Eastern Cape Province, King William's Town Division, near Buffalo River, 174—305m [Lecto. PRE]. *Drège s.n. (IV, C, c),* South Africa, Eastern Cape Province, between Vanstaadensberg & Klaasniemandfontein, alt. 800ft (= 244m) [Syn. *n.v.*].

Xysmalobium dealbatum (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As above.

Gomphocarpus dealbatus (E. Mey.) Decne., in DC. Prod. 8: 563 [1844]. **Types:** As above.

Asclepias dealbata (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 6 [1896]. **Types:** As above.

Pachycarpus ligulatus E. Mey., Comm. Pl. Afr. Aust.: 545 [1838]. **Types:** *Drège 2223,* South Africa, Eastern Cape province, Uitenhage Division, between Coega & Sundays Rivers, 300m [Lecto. K].

Xysmalobium dealbatus (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above.

Xysmalobium ligulatum Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above

Asclepias alatus Schltr., Verh. Bot. Verenis Prov. Brand. 35: 6 [1893]. **Type:** *Schlechter 2217,* South Africa, Western Cape province, Zuurbraak, Swellendam, 260m, June 1893 [*n.v.*].

Discussion: We have placed *P. dealbatus* next to *P. galpinii*, which it resembles. Like this species it bears similarities to *Pachycarpus* subgenus *Parapodiopsis* and *Xysmalobium*. Viz., it has a similar shaped urceolate corolla with lobe tips reflexed and a simple corona-lobe lacking any ornamentation. However, its vegetative facie, larger corona-lobes and fruit structure place it squarely in *Pachycarpus*. This species varies widely over its range with specimens in the southwest having leaves linear to lanceolate with apex acute and follicles with thin longitudinal ridge-like wings. However, specimens to the northeast have leaves broadly oblong, ovate to elliptic with apex obtuse but mucronate, and follicles with large wing-like longitudinal ridges that are deeply lobed along their margin (Smith, 1988). Interestingly, those specimens with smaller flowers (e.g. *Wood 4247*) resemble species of subgenus *Parapodiopsis* in general facie. Flowering November to March, rarely later, peaking December. A very distinct ecotype of this species occurs in the Nongoma and Babanago Districts of Zululand. Because it is so distinct and because an examination of a wide range of material has revealed no intermediates, we have decided to give it subspecific status. The type in PRE was seen by N.E. Brown in 1905. He writes on the specimen "This matches the type in E. Meyer's herbarium."

Distribution: South African endemic. This is one of the most widespread *Pachycarpus* species, being found in the following provinces: Western Cape, Eastern Cape, KwaZulu-Natal and southern border region of Mpumalanga.

Key to Varieties:

1a. Corolla catilliform with gynostegial-column exposed; corona-lobes more or less narrow to the apex, spreading horizontally away from the the gynostegial-column leaving it exposed, only tips erect ..... subsp. *dianneae*

1b. Corolla globose or urceolate with gynostegial-column enclosed; corona-lobes narrow at the base expanding to a slightly broader, shortly horizontal then abruptly erect, closely surrounding the gynostegial-column, erect for most of their length ..... subsp. *dealbatus*

2a *Pachycarpus dealbatus* E. Mey. subspecies ***dealbatus***

Discussion: This subspecies is more widespread than subspecies *dianneae* and exhibits a greater range of variation. The corolla is cup-like enclosing the gynostegial-column. The corona-lobes are simple and ligulate, shortly horizontal at the base and then abruptly erect. The basal part is narrower than the erect part which is slightly broader and closely surrounds the gynostegial-column. The flowers of this subspecies are very similar looking to *P. galpinii*, distinguished by being bigger and having a differently shaped corona-lobe. The corona-lobes of subsp. *dealbatus* and *P. galpinii* are similar in being relatively simple and unornamented, but the similarity ends here. In subsp. *dealbatus* the margins are straight rather than reflexed, making the inner and outer face flat rather than ridged and grooved respectively (fig. 6). Specimens from the Eastern Cape have leaves that are sometimes similar to those found in *Xysmalobium*; confirming this species near basal position within *Pachycarpus*. Plants are found in open grasslands, often amongst

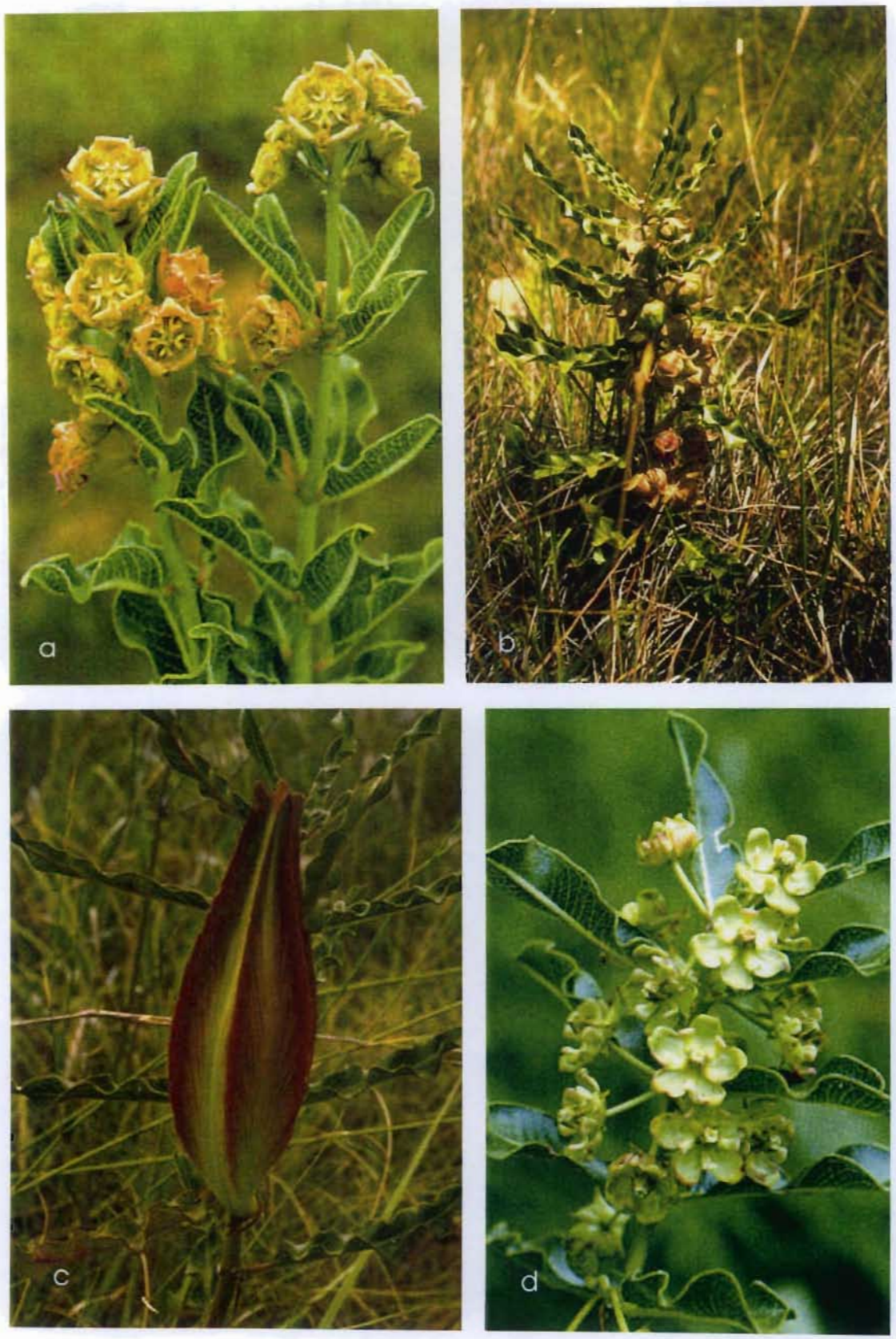

Figure 6. *Pachycarpus dealbatus* subsp. *dealbatus*: a. Flowering stems [KwaZulu-Natal plant]; b. Whole plant showing habit & habitat (500mm tall) [Eastern Cape plant]; c. Follicle [Eastern Cape plant]. *P. dealbatus* subsp. *dianneae*: d. Flowering stem. Photographs: a by L. Greene; b & c by A. Nicholas and; d by M. von Fintel.

rocks and in situations that are regularly burned. They have a long flowering period, from November to June, and occur at altitudes of between 250 and 1600 meters. Illustrated in Smith (1980 & 1988).

Distribution: As for the species (fig. 7).

Conservation Status: Vulnerable to threatened in many areas.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 1009,* between Ixopo & Richmond [NH]; *Nicholas 1759 with van den Berg*, between Vryheid & Melmoth by Umfolozi bridge [CPF]; *Nicholas 2764 with Poorun & Govender*, Loteni [UDW]; *Goyder 3936 with Nicholas*, between White Mountain Inn & Kamberg [K]; *Acocks 9925*, Estcourt Nature Reserve [NH, PRE]; *MacDevette 718*, Nsuze River valley [NH]; *MacDevette 688*, Nsuze River valley [PRE]; *Harriss 116*, Vergeleegen Nature Reserve [NU]; *Manning 321*, 'Greene's farm', Estcourt district [NU]; *Strey 4229*, Kranskop [PRE]; *Green 498*, Kempton [NH]; *Wood 4247*, Biggersberg [NH]; *Haygarth s.n.*, Entumeni [NH 15924]; *Strey 4229*, Kranskop [NH]; *Wood 5830*, Charlestown [PRE]; *Tyson 3153*, St. Andrews Mission [PRE]; *Phelan 213*, Loteni Nature Reserve [NU]. Eastern Cape: *Nicholas 2709*, Zuurberg National Park [PRE flowers & fruit]; *van Zinderen Bakker 62*, Prince Alfred Pass [BLFU]; *Daly 564,* Trappes Valley [NH]; *Sim 1309,* King William's Town [NH]; *Karsten 25261*, Grahamstown [PRE]; *Brusse 5094*, Franklin [PRE]; *Hutchinson 1820*, Mt. Currie [PRE]; *Acocks 20252*, Cathcart [PRE]; *Acocks 17918*, near Queenstown [PRE]; *Bolus 10203*, Kei River valley [PRE]; *Burtt Davy 12045*, Kabeljaaw, near Humansdorp [PRE]; *Hilliard & Burtt 18917*, Swartberg, Matatiele [NU]. Western Cape: *Taylor 9022,* Plettenberg Bay [NBG]; *Marloth 3513*, Swellendam [PRE]; *Muir 2534*, Kampscheberg [PRE]; *van Breda 1169*, Canagas [PRE].

2b. *Pachycarpus dealbatus* E. Mey. subspecies ***dianneae*** Nicholas. *Subsp. Nov.* **Type:** *Williams 303,* South Africa, KwaZulu-Natal, Babanango District, Goudhoek Farm [Holo. NH]. ***Caulis*** *erectus, ±600mm elatus.* ***Folio*** *lamina linearis ad ovatus, coriaceus, (33-)*

42—68mm longo, (9-)18—36mm latus, margine plano et incrassatus parum, nervatura prominens. ***Inflorescentia*** *umbelliformis, sessile.* ***Floribus*** *4—8(-12) per inflorescentibus; pedicellatibus 25—30mm longo.* ***Corolla*** *catilliformis, ad basis divisus, gynostegio-columna expositus; lobus oblongus ad ovatus, 15—15mm longus, 6—8mm latus; flavovirens purpureus notatus.* ***Staminalis coronae*** *±1.5mm super gynostegio-columna basim exorientia, lobi-exterior ligulatus 7.5—10mm longus, dimidium basilaris extendens horizontalis, dimidium distale erectus, non ornatus, non arte congestus circum staminalis-column.* ***Staminalis-columna*** *conicus, ±6mm elatus.* ***Styli-apicem*** *truncatus.* ***Folliculi*** *solitarius, erectus, ellipticus, semi-inflatus, ±70mm longus, ±32mm latus, cum longitudinalis tenuis alae.*

Description: *Habit*: A perennial geophytic herb; with milky latex. *Underground organ*: a narrow cylindrical fleshy deep-seated stem-tuber. *Stems* ±600mm tall, erect, cylindrical at base, flattened & chaneled above, short strigose hairs all over. *Leaves* opposite, simple, entire, spreading to spreading erect, petiolate; lamina ovate, linear, lanceolate to obovate (sometimes all shapes on one plant), (33-)42—68mm long, (9-)18—36mm wide, coriaceous, apex acute to subacute & apiculate, base cuneate, rounded to truncate, margins slightly thickened, all level of veins prominent abaxially, sparse to dense strigose on both surfaces; petiole 5—10mm long. *Inflorescences* sessile, umbel-like & lateral at the nodes, 6—8 per stem, usually 1 occasionally 2 at each nodes, 4—8(-12)-flowered; bracts caducous. *Flowers* 20—26mm diam.; pedicels 25—30mm long. *Sepals* ovate, 12—15mm long, 5—6mm wide, almost as long as the petals, apex acute, adaxial surface glabrous, abaxial surface with many long strigose hairs. *Corolla* catilliform, spreading with tips erect, divided to base; petals oblong to ovate, 15—18mm long, 6—8mm wide, pale yellow-green with purple markings on the outside of the petals. *Staminal-corona* in 2 unequal alternating 5-merous series produced ±1.5mm above the corolla base; outer-corona not closely crowded around the column, ligulate, 7.5—10.0mm long, spreading horizontal portion 4—5mm long, becoming erect in the distal half which is 3.5—5.0mm

long, base 0.8—2.0mm wide at base, almost the same width throughout or apex only slightly dilated 1—3mm wide, obtuse & slightly reflexed, upper surface without wings; inner-corona reduced to vestigial bump-like structures at the gynostegial-column base. *Staminal-column* conical, 6.0—6.2mm tall; anther-wings very large & cornified, 4—5mm long, 6—8mm wide at the beaked base, outer margin curved, cornified surfaces of adjacent anther-wings joined basally; anther-appendages ovate, 2.0—2.2mm, 1.8—2.0mm wide, inflexed over the style-apex margin & almost connivent at the tips. *Pollinaria*: Pollinia ovate, 1.0—1.2mm long, 0.6—0.75mm wide, small in comparison to rest of apparatus, dorso-ventrally flattened attached apically to the translator-arms; translator-arms large 1.2—1.5mm long, 0.5—0.7mm wide; corpusculum large elliptic ±1mm long, 0.4—0.5mm wide. *Style-apex* 4.5mm diam., truncated with 5 triangular fleshy ridges & centrally depressed. *Fruits* solitary, erect, elliptic, semi-inflated, ±70mm long, ±32mm wide, surface with long, thin longitudinal wings up to 20mm wide. *Etymology*: Named after Dianne Smith (*née* Harriss) who revised *Pachycarpus* for southern Africa, making a considerable contribution to the taxonomy and nomenclature of the genus for this region.

Discussion: This subspecies differs from the type subspecies in its corolla being shallow and saucer-like rather than campanulate. As a result of this, the gynostegial-column is exposed rather than hidden. The corona-lobes are narrowly linear from base to apex, rather than narrow at the base (rarely broad) and dilating to a blunt apex. These corona-lobes spread horizontally for some distance before becoming erect and are thus not closely crowded around the gynostegial-column, rather than shortly horizontal and closely crowded around the gynostegial-column as in the type subspecies (fig. 6). These difference are so profound that we have opted for subspecific rather than varietal rank, even though the new taxon is allopatric with the type subspecies. The floral differences may indicate a different pollination syndrome for both subspecies. Ethnological factors such as this could cause speciation, through reproductive isolation, even though sister

taxa are sympatric. Pollination and reproductive experimentation needs to be done to validate this. However, the absence of hybrids suggests that some degree of reproductive isolation exists between these two allopatric subspecies. The Zulu names *Ishongwe* and *uKathumuthi* for this taxon occur on some Gerstner specimen labels. Plants are found growing in bushveld grasslands or in recently burnt grassveld. Flowering occurs from December to February.

Distribution: South African endemic [KwaZulu-Natal province (Zululand only, in the Nongoma and Babanonga Districts)] (fig. 7).

Conservation Status: Data Deficient following Scott-Shaw (1999). Probably vulnerable.

Representative Specimens: South Africa: KwaZulu-Natal: *Gerstner 4435 & Gerstner 4652*; Nongoma District, Wendelane [both in NH]; *Pooley 270*, near Jozini [NU].

Table 2. Differences between *Pachycarpus dealbatus* variety *dealbatus* and variety *diannaea*.

Character	var *dealbatus*	var. *diannaea*
Stem height	150—520mm	±600mm
Flower color outside	Brown-green or pale green with purple brown markings	Pale yellow-green with purple markings
Flower diameter	10—23mm	20—26mm
Corolla shape	Globose-campanulate	Shallow & saucer-like
Petal orientation	Erect	Spreading
Petal length	15—16mm	15—18mm
Gynostegial-column	Hidden	Exposed
Gynostegial-column stipe length	0—1mm	±1.5mm
Corona-lobe shape	Narrow below greatly dilated apically	Narrow throughout or only slightly dilated apically
Corona tip apex	3.0—6.0mm	2.0—2.5mm
Corona orientation	More or less immediately erect	Spreading horizontally then erect near the tip

Corona/Gynostegial-column relationhip	Crowded close to the gynostgeial-column	Separated by a distinct gap from the gynostegial-column

3. *Pachycarpus lebomboensis* D.M.N. Smith, in Notes Royal Bot. Gard. Edinb. 41(2): 300—302 [1983]. **Type**: *Harriss 96,* South Africa, KwaZulu-Natal Province, Ubombo District, Mkuze Game Reserve, Mhlekazi trading store [Holo. NU]

Discussion: The corona-lobes of this species are long, narrowly linear through-out and unornamented except for a pair of small teeth at the base. Smith (1988) considered these to be vestigial, but they could also be seen as the beginings rather than the demise of ornamentation. In its corona-lobe structure *P. lebomboensis* resembles *P. dealbatus* (Smith, 1988), in particular subspecies *dianneae*. However, besides the basal teeth there are also other differences between these species: In *P. lebomboensis* the corona-lobe apex is sometimes bifid, in *P. dealbatus* the apex is usually blunt, rarely emarginate and never bifid. The corona-lobe orientation also differs between the two and, although, it may sometimes just overtop the style-apex in *P. dealbatus*, in *P. lebomboensis* it greatly exceeds the style-apex. The two species also differ in leaf-shape, in *P. lebomboensis* some of the leaves are trullate in shape. However, these differences must not detract from the closeness of these two species. Because of this closeness we have placed it in our basal group. Interestingly, Smith (1980) points out the fact that the leaves have a softer texture, like *Xysmalobium undulatum*. Also the leaves resemble those of *P. schinzianus* and *Xysmalobium stockenstromense*, supporting our belief that this basal group has some connection to *Xysmalobium*. This species occurs in open grassy areas amongst woodlands (fig. 16). Flowering occurs from December to January. Illustrated by Smith (1980, as species a & 1988).

Distribution: South African endemic [KwaZulu-Natal province (Zululand only, confined to the area around the Lebombo mountains)] (fig. 7).

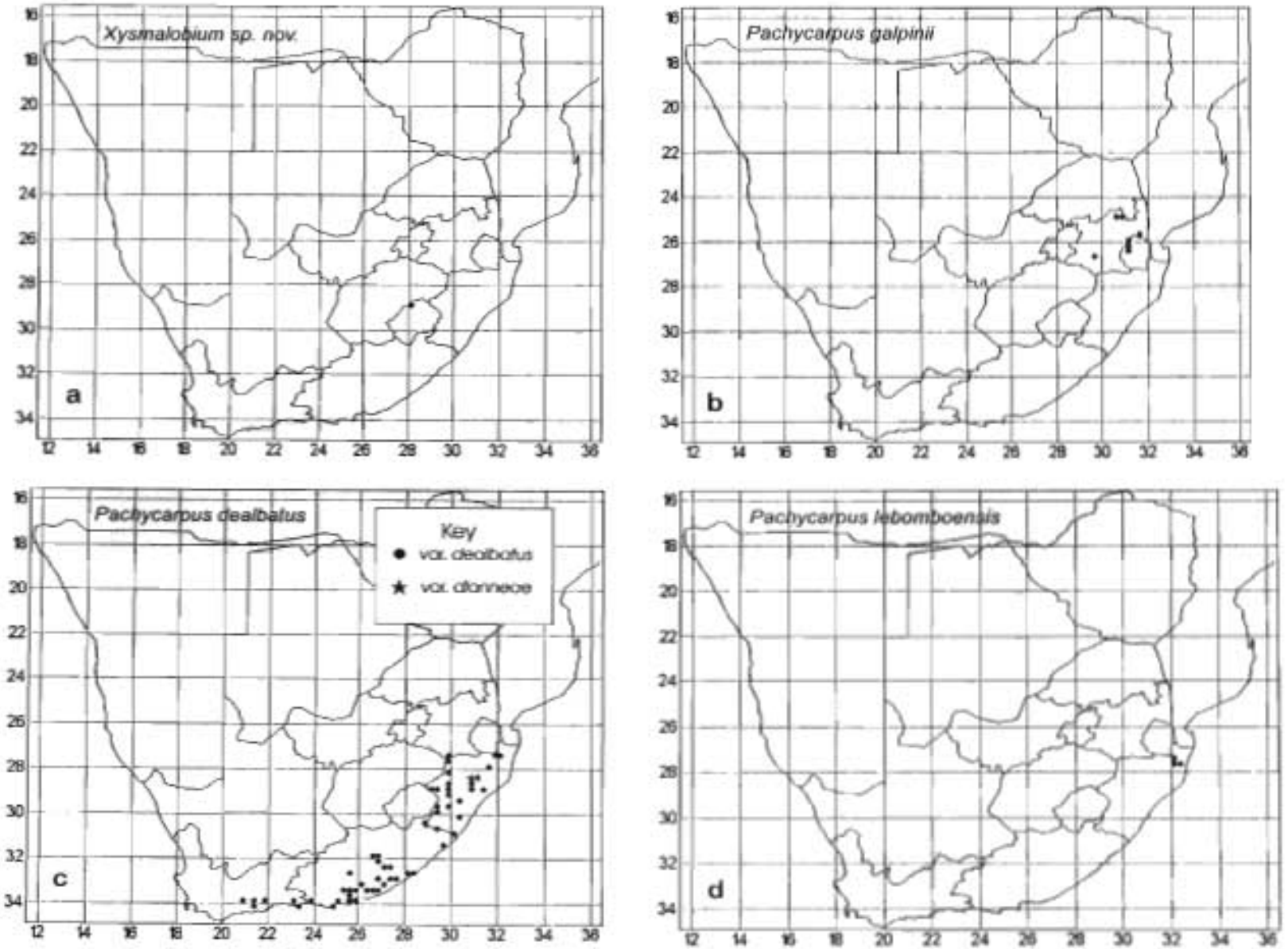

Figure 7. Distribution maps of: a. *Xysmalobium sp. nov.*; b. *Pachycarpus galpinii*, c. *P. dealbatus* and; d. *P. lebomboensis*.

Conservation Status: Low Risk (Near Threatened) following Scott-Shaw (1999). Although very restricted in distribution, this species is, to a small extent, protected in the Game Farms that abound in the area and also by the fact that it occurs in the Mkuzi Game Reserve. However, it has been seldom collected despite this.

Representative Specimens: South Africa: KwaZulu-Natal: *Harris 123*, Lebombo mountains near Jozini [NU]; *Goodman 1219,* Mkuze Game Reserve [Mkuzi, NH]; *Goodman 825*, Mkuze Game Reserve [Mkuzi].

4. ***Pachycarpus rigidus*** E. Mey., Comm. Pl. Afr. Austr.: 211 [1838]. **Type:** *Drège s.n.,* South Africa, Eastern Cape province, Tarka Division, Wildschuttsberg, 1372—1524m [Holo. B† Iso. K].

Xysmalobium rigidum (E. Mey.) Dietr., Syn. Pl. 2 : 902 [1840]. **Type:** As above.

Gomphocarpus rigidus (E. Mey.) Decne., in DC. Prodr. 8: 563 [1844]. **Type:** As above.

Asclepias rigidus (E. Mey.) Schltr., Journ. Bot. 33: 357 [1895]. **Type:** As above.

Pachycarpus rigidus E. Mey. var. *tridens* E. Mey., Comm. Pl. Afr. Austr.: 211 [1838]. **Type:** *Drège 6393,* South Africa, Eastern Cape province, Aliwal North Division, foot of the Wittebergen (in uneven mountains near Rietvalei, alt. 5500ft in Meyer 1838) [Holo. B† Iso. K]. Possible isosyntype at MEL (Forster, 1994).

Gomphocarpus rigidus (E. Mey.) Decne. var. *tridens* (E. Mey.) Decne., in DC. Prodr. 8: 563 [1844]. **Type:** As above.

Discussion: The corona-lobes of this species are particularly interesting, in that they show a wide range in variation in a character that is usually very conservative. Like *P. dealbatus* these corona-lobes are without basal teeth or wings on the horizontal basal portion. In some specimens, the erect apical portion is dilated and ovate in shape, in this too these specimens are similar to *P. dealbatus*. However, in other specimens the apical

portion is deeply divided, trifid or claw-like to cruciform. The specimens with the apex trifid to cruciform were placed in var. *tridens* by E. Meyer (1838). When the two extremes of this character are examined this division seems valid, however, as was pointed out by Smith (1988) many specimens can be found between the two extremes (which may even occur together) and no clear discontinuity can be found to support infraspecific division. We have, thus, continued to follow Smith (1988) in not recognizing varietal taxa. Despite the similarity of some specimens to *P. dealbatus* this species can immediately be distinguished by its slightly dilated corona-lobe apex (never ovate to cruciform), and flowers and inflorescences which are usually larger. As pointed out by N.E. Brown (1908), Drège types he saw in Meyer's Herbarium (with duplicates at Kew) indicate that Meyer (1838) transposed the specimens he cited for var. *rigidus* and var *tridens*. One specimen we have seen (*Boardman A10* housed in PRE) may prove to be something new, but allied to *P. rigidus* or possibly *P. stenoglossus*. This specimen has the erect part of the corona-lobe narrowly ovate in shape with the tip like the teat on a bottle, the basal horizontal portion appears to have no wings, but close inspection shows these to be present and tightly appressed (squashed) against the gynostegial-column. The anther-wings are widely notched at the protruding base of the heavily cornified anther-wings. This specimen also does not occur within the normal distribution range of *P. rigidus*.

The Sotho call the plant *Phôma-metsu* or *Leshokoana* (= small *Leshokhoa*). They use it for treating the pains caused by colic (Phillips, 1917) and as a vegetable (Watt & Breyer-Brandwijk, 1962). Flowering occurs from November to February, peaking December, rarely earlier (as early as September) or later. Ants are constant nectar robbers in almost all large flowered Asclepiadaceae (although possibly pollinators in smaller flowered species), so it is interesting that one specimen we examined [*Gemmell s.n.*] has ants that have died because they have become irreversibly stuck in the gynostegial-groove produced by tightly contiguous anther-wings. Plants occur at altitudes of between 600 and 2000 meters. Illustrated by Smith (1980 & 1988).

Distribution: Southern African endemic. Lesotho, South Africa [Gauteng, Mpumalanga, Free State, KwaZulu-Natal & Eastern Cape provines] and Swaziland (fig. 9).

Conservation Status: Threatened to vulnerable in some areas only.

Representative Specimens: Lesotho: *Jacot Guillarmod 1911*, Monethi's [PRE]; *Roux 1483*, Thaba-Tseka [PRE]; *Dieterlen 377*, Sebothoane [PRE]. **South Africa:** Gauteng: *Burtt Davy 3122*, Witkleifontein near Heidelburg [K, PRE]; *Gilfillan 222*, Grootvlei farm, Heidelberg [PRE]. Mpumalanga: *Burtt Davy 1004*, Road between New Denmark & Morgenzon [K]; *Burtt Davy 958*, Blesbokspruit [PRE]. Free State: *Ross 70*, Fouriesburg [NU]; *Peeters, Gericke & Burelli 365*, Thabanchu Mountain [PRE]; *Stokoe 1518*, Wynford [PRE]; *Maree 81*, Zastron [PRE]; *Flanagan 2069*, Bethlehem [PRE]; *Gemmell s.n.*, Eagles Nest, Bloemfontein [BLFU 8450]; *Acocks 13891*, near Reitz Banks of Liebenberg Vlei [PRE]; *Ferreira 102*, Kranskop [PRE]. KwaZulu-Natal: *Schweickerdt s.n.*, Van Reenen [PRE]; *Schweickerdt 30829*, Klipriver [PRE]. Eastern Cape: *Thode A421*, Burgersdorp [NH]; *Galpin 2277*, Lesseyton Nek [PRE]; *Goossens 897*, Doornkop [PRE]; *Flanagan 759*, Komga [PRE]; *Bolus 170*, Elandshoek, near Aliwal North [PRE]; *Thode 491*, Burgersdorp [PRE]; *Gerstner 192B*, Barkley East [PRE]. **Swaziland:** *Bolus 12127*, near Mafwtane [PRE].

5. *Pachycarpus schinzianus* (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 376 [1902]. **Type**: *Schlechter 3528,* South Africa, Gauteng Province, near Heidelberg, 1585m, 21.10. 1893 [Holo. B† Iso. BOL, K, MEL (*fide* Forster 1994), NH, PRE].

Gomphocarpus schinzianus Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 37 [1895]. **Type:** As above.

Asclepias schinzianus (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As above.

Discussion: Like other species in the basal group this has a relatively simple corona-lobe. It is tongue-like with the erect apical portion dilated, slightly hooded, greatly over-topping the style-apex and slightly inflexed. At the base, on the upper surface of the horizontal portion of the lobe are two erect triangular teeth-like contiguous appendages. Inflorescences are produced corymbosely on the stems so that all the flowers are more or less at the same level, this is a feature not seen in many other species of *Pachycarpus*. One specimen [*Gilliland 26864*] has extremely long peduncles even for this species. The flowers (corolla and corona-lobes) are white or cream and tinted purple, and often produced in mass; making this species a very attractive sight in highveld grasslands (fig. 8). The glucosides of this species have been studied in some detail by Schmid *et al.* (1959). Flowering occurs from September to February, peaking November, rarely as late as June. Plants can be found at altitudes of between 1220 and 1525 meters. Illustrated Anonymous (1926) and Smith (1980 & 1988).

Distribution: Southern African endemic. Lesotho and South Africa [Northern, North west, Gauteng, Free State, Mpumalanga & KwaZulu-Natal provinces] (fig. 9).

Conservation Status: Threatened and vulnerable in some areas only. This species is most common in Gauteng, unfortunately, this has become the most industrialized province in South Africa.

Representative Specimens: Lesotho: *Dieterlen 189*, Sehamelo [PRE]. **South Africa:** Northern: *Murray 603*, Pietersburg [PRE]; *Burtt Davy 2128*, Springbok Flats [PRE]; *Galpin 13477*, Naboomfontein [PRE]. North West: *Hanekom 1504*, Wolverand, Klerksdorp [K, PRE]; *Jacobsen 1119*, Rustenburg Nature Reserve [PRE]; *Liebenberg 147*, Koster at Vlakfontein [PRE]; *Louw 486*, Boskop [PRE]; *Acheson 5953*, Potchesfroom [PRE]; *Dyer 4757*, Sommerville farm, Ventersdorp [PRE]; *Goossens 1623*, Klington [PRE]; *Botha & Ubbink 1751*, Vliegveld [PRE]; *Meyer 976*, Doornfontein farm,

Figure 8. *Pachycarpus schinzianus*: a. Whole plant showing habit (400mm tall); b. Close up of corymbosely arranged inflorescences; c. Close up of flowers and; d. Sparsely wooded highveld grasslands habitat in which this species is found, one plant indicated by an arrow. *P. mackenii*: e. Holotype Gerrard & McKen 1284 (TCD); f. Flowering stem and; g. Close up of flowers. Photographs: a to d & f to g byA. Nicholas; e by Kew Photographer.

near Ottosdal [PRE]; *Hanekom 1504*, Wolwerand, near Kleksdorp [PRE]; *Phillips 23*, Tarlton [PRE]; *van der Westhuizen 885*, Dassiesrand [[PRE]. Gauteng: *Nicholas 2706*, Pretoria [PRE]; *Nicholas 2793 with Baijnath & Singh*, near Suikkerbossie Rand Nature Reserve [UDW]; *Gilliland 26864*, Klipriver, West Rand [PRE]; *Rogers 18978*, Premier Mine [NH]; *van Rooyen 2071*, Roodeplaat Dam Nature Reserve [PRE]; *Leeman 12*, Time Ball Hill [PRE]; *Strey 3139*, Byenespoort [PRE]; *Acocks 20842*, Heidelberg [PRE]; *Bradfield 277*, Benoni [PRE]; *Burtt Davy 9117*, Uitgevallen [PRE]; *Davies 13*, Irene [PRE]; *Gerstner 6256*, south of Johannesburg [PRE]; *Liebenberg 8594*, Randburg [PRE]; *Prosser P1140*, Magaliesberg [PRE]; *Pole Evans H12865*, Kaalfontein [PRE]. Mpumalanga: *Francois 91*, Belfast Road [NU with photo]; *Thode A1626*, Botsobelo [NH, PRE]; *Westfall 726*, Thabazimbi, Kransberg [PRE]; *Coetzee 449*, Slangspruit [PRE]; *Burtt Davy 7313*, Klein Spekboom River, near Lydenburg [PRE]; *Thorncroft 3068*, Zwartkop range, Sheba [NH]; *Gower s.n.*, Botsabelo [PRE 51416]; *Theron 1611*, Loskop Dam Nature Reserve [PRE]. Free State: *Theron 622*, Sasolburg [PRE]; *Potts 2678*, Rendezvous Station [BLFU]; *de Preez 315*, Vredefort, Gatama [BLFU]; *Theron 622*, Sasolburg, Hoeveldtuin [PRE]. KwaZulu-Natal: *Acocks 10749*, Riet Vallei 221, Rietvlei 453, near Weenen [PRE].

6. *Pachycarpus stenoglossus* (E. Mey.) N.E. Br., in Fl. Cap. 4(1): 727 [1908]. **Type**: *Drège 3419,* South Africa, Eastern Cape province, Aliwal North Division, Witteberg range, 1830—2100m [Holo. B† Iso. K; fragment only].

Pachycarpus vexillaris E. Mey. var. *stenoglossus* E. Mey., Comm. Pl. Afr. Austr.: 212 [1838]. **Type:** As above.

Discussion: This was first described as a variety under *P. vexillaris* (Meyer, 1838), however, the corona-lobes are quite different and so it was quite rightly raised to specific status by N.E. Brown (1908). The corona-lobes of this species are typical of the basal

group, however, unlike the other members of this group it has a pair of subquadrate-shaped wings on the upper surface of the horizontal basal section. In this respect it begins to show connections with a number of the other groups, particularly groups 2 & 4. The specimen at Kew consists of a leaf, flower and drawing of Meyer's type by M. Smith. Flowering January.

Distribution: South African endemic [Eastern Cape province only] (fi.g 9).

Conservation Status: According to Smith (1988) *P. stenoglossus* is known from only two widely separated (spatial and temporal) collections. Field work undertaken by the senior author at the type locality (fig. 16) in January 1996 failed to turn up any specimens of this species. The area has suffered from a number of years of *el-nino* induced drought and is also heavily over-grazed by cattle. *P. stenoglossus* must be considered endangered and possibly even extinct at the type locality.

7. ***Pachycarpus vexillaris*** E. Mey., Comm. Pl. Afr. Aust.: 212 [1838]. **Types**: *Drège 3418,* South Africa, Eastern Cape province, Aliwal North Division, Witteberg range, in mountain grasslands [Lecto. K]. *Drège s.n. (IV, B, C),* South Africa, Eastern Cape province, occuring in rocky hills between Grootfontein & Ganzekraal, alt. 1500—2000ft (= 457—610 meters) [Syn. *n.v.*]. *Drège s.n. (IV, C, c),* South Africa, Eastern Cape province, between Kopje & Zwarskopsrivier, alt. 500ft (= 152 meters) [Syn. *n.v.*].

Xysmalobium vexillare (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As above.

Pachycarpus vexillatus, in error, Steud., Nom. Bot. 2 edn. 2: 245 [1841]. **Types:** As above.

Asclepias vexillare (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Types:** As above.

Discussion: This species is found in areas along the eastern mountainous back bone of the subcontinent. Meyer (1838) divided this into two varieties: *vexillaris* and

stenoglossus. The latter is quite distinct and was elevated to specific rank by N. E Brown (1908). This taxon has the most remarkably complex corona-lobe: The upper surface bears two long tooth-like and reflexed wings, the apex is cruciform with the very tip occasionally bifid and then inflexed. Sometimes this structure resembles the vexillum of the Fabaceae flower; hence the specific epithet. The Sotho apparently eat both the leaf and rootstock (Guillarmod, 1971). Plants flower from November to March, peaking in January, and occur at altitudes of between 1200 and 2600 meters. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. Lesotho, South Africa [Eastern Cape & Western Cape (northeastern)] (fig. 9).

Conservation Status: Probably vulnerable in many areas although, to some degree, protected by its high altitude distribution.

Representative Specimens: Lesotho: *Liebenberg 5804,* Mokhotlong [PRE]; *Schmitz 8526*, Molimo Nthuse [PRE]; *Coetzee 840*, Khybely Valley [PRE]; *Hoener 1882*, Sehlabathebe National Park [PRE]; *Jacot Guillarmod 2289*, Liseleng Stream Valley [PRE]; *Roux 1392*, Ongeluk's Nek [PRE]; *Liebenberg 5804*, without precise locality [PRE]. **South Africa:** Eastern Cape: *A & G. Hutchings 1930*, Thaba Chitja [PRE]; *Bester 1973,* Naudesnek Pass, farm Glen Lynden [NH]; *Acocks 18680,* Penhoek Pass, Wodehouse region [K, NH, PRE]; *Phillipson 612*, Drakensberg near Barkly East [UFH]; *Acocks 19142*, de Nek, Graaf Reinet [PRE]; *Acocks 21055*, Moltkeblick, Noordhoek [PRE]; *Galpin 2267*, Andriesberg [PRE]; *Galpin 2675*, upper Swart Kei [PRE]; *Roux 1718*, Spioenkop farm, near Indwe [PRE]; *Thode 491*, Burgersdorp [PRE]; *Acocks 21858*, Lucernvale [PRE]; *Matthews 789*, Ossa farm, near Jouberts Pass [PRE]; *Stewart 1907*, near Elands Height [NU]; *Hilliard & Burtt 16597*, Rhodes to Naudis Nek [NU]. Western Cape: *Burke s.n.*, Beaufort West Division [K].

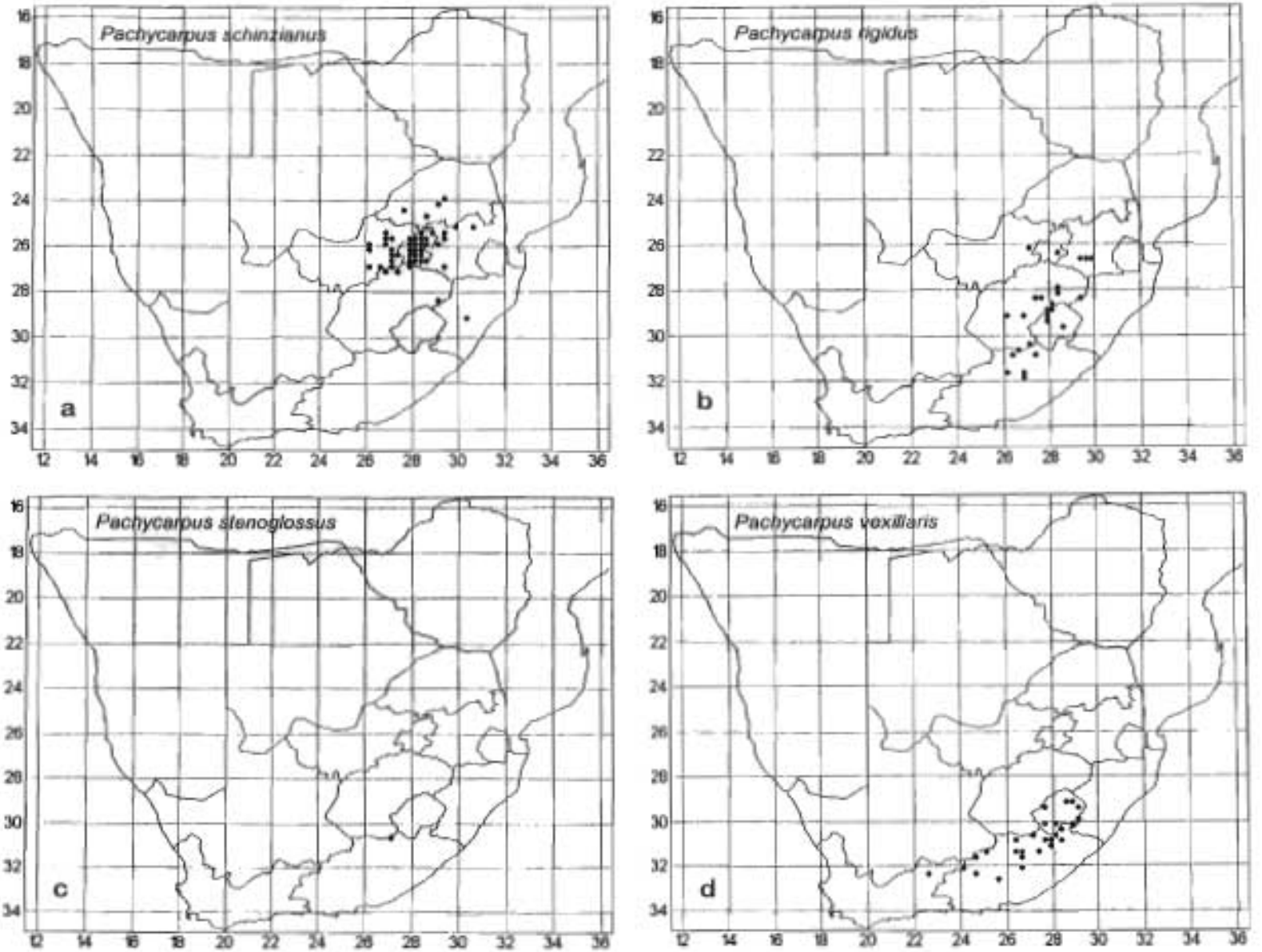

Figure 9. Distribution maps of: a. *Pachycarpus schinzianus*; b. *P. rigidus*; c. *P. stenoglossus* and; d. *P. vexillaris*.

8. *Pachycarpus mackenii* (Harv.) N.E. Br., in Fl. Trop. Afr. 4(1): 337 [1902]. **Type**: *Gerrard & Mcken 1284,* South Africa, KwaZulu-Natal, Zululand, without precise locality [Holo TCD Iso. K; fragment].

Gomphocarpus mackenii Harv., Thes. Cap. 2: 60 & t. 194 [1863]. **Types:** As above.

Asclepias mackenii (Harv.) Schltr., in Journ. Bot. 34: 454 [1896]. **Type:** As above.

Discussion: This species is, so far, only represented by the type collection only; although it may have been photographed by the senior author (fig. 8). As a result, not much is known about *P. mackenii*, not even its exact locality. According to the specimen label it flowers in January. The type was seen by the senior author during a working visit to Trinity College Dublin in 1989. Smith (1980 & 1988) placed this species after *P. grandiflorus* in her treatment, indicating her opinion that the two species are possibly allied; although she does not explicitly say so. We agree with this placement and have continued to follow her here. To an extent this species forms a link between groups 1and 2, and even groups 3 and 2. The flowers are not as large as in *P. grandiflorus*, but are just as spectacular and as profuse. The corolla is saucer-shaped, being fused in the lower half, with the gynostegium stalked and presented to pollinators, rather than hidden from them.

Distribution: South African endemic [KwaZulu-Natal Province only].

Conservation Status: Critically Endangered. Data Deficient according to Scott-Shaw (1999). This species has not been recollected in over 120 years.

9. *Pachycarpus grandiflorus* (L.f.) E. Mey., Comm. Pl. Afr. Aust.: 209 [1838]. **Type**: *Thunberg s.n.,* South Africa, Western Cape province, Kromrivier [Holo UPS. Photo. NU] (fig. 10).

Asclepias grandiflora L.f. Supp. Plant. Sys. Veg. 13th edn.: 170 [1781]. **Type:** As above.

Xysmalobium grandiflorum (L.f.) R. Br., in Mem Wern. Soc. 1: 39 [1809]. **Type:** As above.

Gomphocarpus grandiflorum (L.f.) Decne., in DC., Prodr. 8: 562 [1844]. **Type:** As above.

Discussion: As pointed out by Dyer (1951), the specific epithet *grandiflora* (= very large flower) is most appropriate. N.E. Brown (1908) using flower color, corona-lobe keel height and vegetative vestiture divided this species into four varieties. However, as the differences recorded were in degree only, this division was felt by Dyer to be questionable. Later Smith (1988) pointed out that since Brown's revision there are now many more specimens available and that examination of this material more or less confirms Dyer's suspicions. Except for subspecies *tomentosus*, which occurs at the northern extreme of the distribution and is consistently villose-tomentose on all above ground parts but the flowers. For the sympatric varieties *grandiflorus*, *elatocarinatus* and *chrysanthus* all the separating characters break down. As a result, we have continued to follow Smith's treatment. This species in the degree of synorganization of its corolla (the lobes being fused for 1/2 to 2/3 of their length) is remarkable in the genus *Pachycarpus*. Illustrations can be found in Smith (1980 & 1988) and Schill & Jakel (1978 pollinarium only).

Distribution: Southern African endemic. South Africa [Mpumalanga, KwaZulu-Natal & Eastern Cape provinces) and Swaziland. Basically found along the eastern margin of the subcontinent (fig. 11).

Conservation Status: Threatened in some areas.

Key to Varieties:

1a Above ground parts glabrous, scabrous, pubescent or subtomentose ..... subsp. *grandiflorus*

1b. Above ground parts, except the flower, villose to tomentose, with long white hairs ..... subsp. *tomentosus*

9a. *Pachycarpus grandiflorus* (L.f.) E. Mey. subspecies *grandiflorus*

Asclepias grandiflora L.f. var. *chrysantha* Schltr., in Bot. Jahrb. 21(5), Beibl. 54: 7 [1896]. **Type:** *Wood in herb. Galpin 3387,* South Africa, Eastern Cape province, East London Division, near East London [Lecto. K, Isolecto. PRE]. *Flanagan 375*, South Africa, Eastern Cape province, near Komga & Kei Mouth [Syn. K. Isosyn. NU, PRE, SAM]; *Krook ex Schlechter 802*, South Africa, Eastern Cape province, Kei River Mouth [Syn *n.v.*]; *Bowker s.n.*, South Africa, Eastern Cape province, Kreilis Country [Syn. n.v.].

Pachycarpus grandiflorus (L.f.) E. Mey. var. *chrysanthus* (Schltr.) N.E. Br., in Fl. Cap. 4(1): 735 [1908]. **Type:** As above.

Pachycarpus grandiflorus (L.f.) E. Mey. var. *elatocarinatus* N.E. Br. Fl. Cap. 4(1): 735 [1908]. **Type:** *Wood 3169,* South Africa, KwaZulu-Natal province, hills above Byrne. March 1885 [Lecto. K; Isolecto. BOL, NH with drawing]. *Hutton s.n.*, South Africa, Eastern Cape province, Keiskamma, King Williams Town [Syn. K]; *Baur 602*, South Africa, Eastern Cape province, Bazeia, Tembuland [Syn. K]; *Wood 3169*, South Africa, KwaZulu-Natal province, Hills above Byrne [Syn. K. Isosyn. NH]; *Wood in Natal herb. 926*, South Africa, KwaZulu-Natal province, hill near Lynedoch [Syn *n.v.*]; *Wood in Natal herb. 589*, South Africa, KwaZulu-Natal province, Peak of Byrne [Syn. *n.v.*]; *Krauss ex Meisner1260*, South Africa, KwaZulu-Natal province, near Durban [Syn. *n.v.*].

Discussion: This is one of the most striking asclepiad when encountered in either the field or herbarium. This is due mainly to its very large flowers which have a brightly

colored globose corolla. This species can only be confused with one other species, *P. coronarius*, which has similar looking flowers, and which was considered conspecific by Schlechter (1896). However, it is quite distinct. It can immediately be distinguished by its quite differently shaped leaves and corona-lobes, number of flowers per inflorescences, degree of synorganization of the corolla and flowering period (Smith, 1980). Subspecies *grandiflorus* has two major forms of flower color, although mainly yellowish green with large dominant irregular purple or purple-brown spots, a pure yellow form also exsists (fig. 10). N.E. Brown (1908) believed this color variant to be associated with corona-lobe differences and placed it in the variety *chrysanthus*. We agree here with Smith (1988) in not recognizing this taxon, but as this different flower color could be associated with different pollinators, perhaps the variation of this species should be re-examined further and more critically. Subsp. *grandiflorus* flowers from November to March, peaking December to February. Plants occur at altitudes of between 30 and 1800 meters.

Distribution: South African endemic [Mpumalanga, KwaZulu-Natal & Eastern Cape] (fig. 11).

Conservation Status: Vulnerable in many areas.

Representative Specimens: South Africa: Mpumalaga: *Pole Evans s.n.*, Jessievale, near Machadodorp [PRE 51455]; *Bruce 268*, Vossmans Beacon [PRE]. KwaZulu-Natal: *Ward 2091*, Hluhluwe Game Reserve [NH, NU, PRE]. *Nicholas 2104 with Neave*, Cunningham's Castle above Byrne Village [CPF, K, MO, NH, PRE]; *Nicholas 2724 with Poorun*, near Byrne [UDW]. *Nicholas 1809*, Weza State Forest [CPF, NH]; *Harriss 172*, Thistlewood farm, Hilton [NU]; *Wylie s.n.*, Greytown [NH 19137]; *Galpin 14838*, Reservoir valley, near Greytown [PRE]; *Harriss 161*, Fort Nottingham Commonage [NU]; *Acocks 13308*, Highflats [PRE]; *Scott 22*, Cathedral Peak [NH]; *Moll 715*, Everglades, Mpendle district [PRE]; *Edwards 98*, Umtamvuna [NU]; *Haygarth ex Wood 10824*, Donnybrook [NH flowers & fruit, PRE]; *Moll 3501*, Spitzkop dam, Karkloof [NH, PRE]; *Strey 7188*, Beacon Hill [PRE]; *Abbott 5920*, Ngele Mountain, slopes of

Figure 10. *Pachycarpus grandiflorus*: a, b & c. Show different color variants; d. Whole plant showing habit & habitat (300mm tall); e. Whole plant showing fleshy narrowly cylindrical deep-seated stem-tuber (characteristic of the genus *Pachycarpus*) indicated with an arrow; f. Close up of flowers and; g. Holotype Thunberg 6258 (UPS). *P. coronarius*: h. Flowering stem. Photographs: a by L. Greene; b by R. Wise; c. by T. Coleman; d to f by A. Nicholas; g. Courtesy of the Institute of Systematic Botany, University of Uppsala and; h by G. Nichols.

KwaShwili [NH]; *Crewe 16*, Lynn Avis farm, near Ixopo [NH]. Eastern Cape: *Nicholas 2304 with Smook*, Mkambati Nature Reserve [NH, PRE]; *Nicholas 2818 with DC Nicholas*, Martindale [UDW]; *van Wyk & Mathews 7837*, Mlamtomkulu river, Lusikisiki district [NH]; *Boardman 296*, near Swartberg [NU]; *Fourcade 5944*, North of Humansdorp [NBG]; *Vlok 930*, Groendal State Forest, Perdekop [PRE]; *Codd 6340*, near Kei Mouth [PRE]; *Daly 619*, Trappes Valley [NH]; *Steyn 21461*, Haga Haga [PRE]; *Bolus 10206*, Idutywa [PRE]; *Story 2412*, near Thornhill, Humansdorp district [PRE]; *Strey 10811*, between Mt. Frere & Cedarville [PRE]; *Strey 9636*, Fynn's Bush [NH]; *Tyson 1766*, Matatiele [PRE]; *van Niekerk KP947*, Port Elizabeth [PRE]; *Acocks 13360*, near Bizana [PRE]; *Britten 911*, Howies Poort [PRE]; *Dyer 4501*, Komga [PRE]; *Acocks 20259*, Dohne Research Station [PRE]; *MacOwan 6787*, Grahamstown [NH]; *Pegler 1329*, Izeli Convent farm, King Williams Town [PRE].

9b. *Pachycarpus grandiflorus* (L.f.) E. Mey. subspecies *tomentosus* (Schltr.) Goyder, in Kew Bull. 53(2): 370 [1998]. **Type:** *Singer ex Galpin 913*, South Africa, Mpumalanga province, in Convalle Umlomati near Barberton, 1300m, April 1890 [Holo. B† Iso. PRE].

Gomphocarpus grandiflorus (L.f.) E. Mey. var. *tomentosus* Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 19 [1894]. **Type:** As above.

Pachycarpus grandiflorus (L.f.) E. Mey. var. *tomentosus* (Schltr.) N.E. Br., in Fl. Cap. 4(1): 735 [1908]. **Type:** As above.

Discussion: In this variety, the stems, leaves, peduncles, pedicels and sepals are densely hairy. As pointed out by N.E. brown (1908), they look velvety, but are actually slightly harsh to the touch. It is distributed only in the north of the species range. Var. *tomentosus* flowers between December and March. Illustrated in Dyer (1951).

Distribution: Southern African endemic. South Africa [Mpumalanga & KwaZulu-Natal provinces] and Swaziland (fig. 11).

Conservation Status: Vulnerable in many areas.

Representative Specimens: South Africa: Mpumalanga: *Codd 10046*, Lothian Forest Station near Graskop [PRE]; *Oliver 53*, White River, Nelspruit [PRE]; *Sidey 1565*, Piet Retief [PRE]; *Henrici 1413*, Ermelo, Athol [PRE]; *Thorncroft 51461*, Barberton [PRE]; *Scheepers 15047*, Spitskop [PRE]; *Pole Evans 51455*, near Jessievale [PRE]; *Devenish 1325*, Retirement [PRE]; *Behr 1080*, Ndubazi Forest Station [PRE]; *Burtt Davy 10034*, Amersfoort [PRE]; *Balsinhas 3137*, Agnes Gold Mine [PRE]. KwaZulu-Natal: *Harriss 133*, Retirement farm, Utrecht district [NU]; *Devenish 1325*, Retirement farm [PRE]. **Swaziland:** *Germishuizen 6180*, Nkomati River, Hhohho district [PRE].

10. *Pachycarpus coronarius* E. Mey., Comm. Pl. Afr. Austr.: 209 [1838]. **Type**: *Drège 4930,* South Africa, Eastern Cape province, hills near Umtata, in grasslands, 300—480m [Holo. B† *n.v.*]

Xysmalobium coronarium (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As above.

Gomphocarpus coronarius (E. Mey.) Decne., in DC. Prod. 8: 562 [1844]. **Type:** As above.

Discussion: Like *P. grandiflorus*, this is a most spectacular species, but one of limited distribution and often associated with Mitsikaba sandstone. In the past this species was often confused with *P. grandiflorus*; the differences between these species are discussed under this later taxon. Although the holotype is destroyed and we have been unable to trace any isotypes, there is a copy of an illustration by M.Smith of E. Meyer's type housed at Kew. Flowering December. Illustrated by Smith (1980 & 1988).

Distribution: South African endemic [KwaZulu-Natal (Port Shepstone district) & Eastern Cape provinces] (fig. 11).

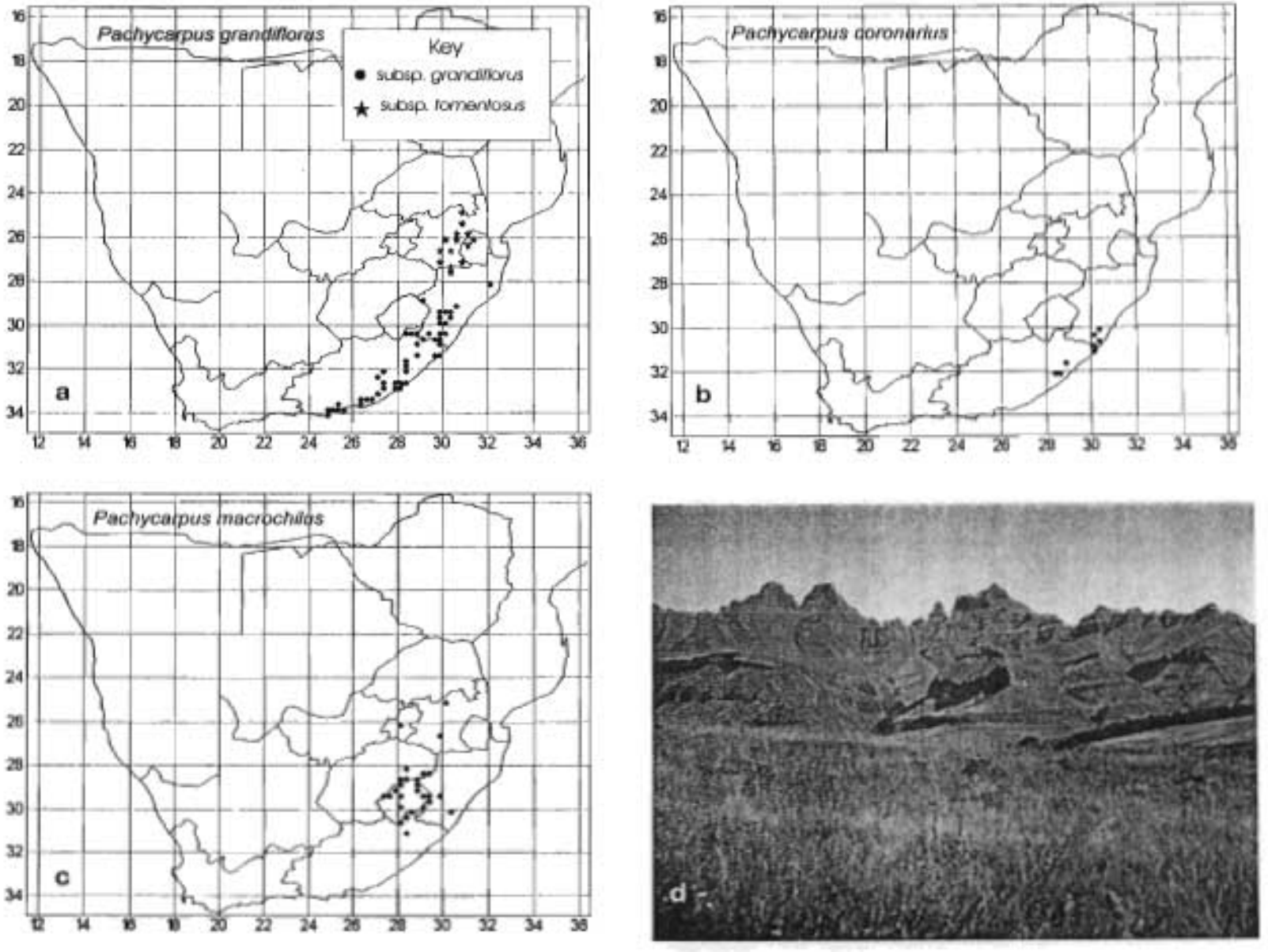

Figure 11. Distribution maps of: a. *Pachycarpus grandiflorus*; b. *P. coronarius*; and c. *P. macrochilus*. d. The northern Natal Drakensberg one of the habitats in which both *P. grandiflorus* var. *grandiflorus* and *P. macrochilus* can be found. Photograph by A. Nicholas.

Conservation Status: Low Risk (Least Concern). This rarely collected species (not more than a dozen specimens have ever been collected) occurs in areas that are heavily populated, over exploited and in which the land is much degraded.

Representative Specimens: South Africa: KwaZulu-Natal: *Abbott 2788*, Umtamvuna Nature Reserve [NH]; *Strey 7188*, Beacon Hill west [PRE]; *Stirton 10487*, St. James Anglican church, Highflats [NH]. Eastern Cape: *Acocks 13227*, near Idutywa [PRE].

11. *Pachycarpus concolor* E. Mey., Comm. Pl. Afr. Austr.: 210 [1838]. **Types**: *Drège s.n.*, South Africa, Eastern Cape province, King William's Town Division, between Chalumna River & Kachu* River [Lecto. K]. *Drège s.n.*, South Africa, Eastern Cape province, between Umzimkulu & Umkomaas, alt. under 500ft (= under 152 meters) [Syn. MEL *fide* Forster (1994)].

Xysmalobium concolor (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As above.

Gomphocarpus concolor (E. Mey.) Decne., in DC. Prod. 8: 563 [1844]. **Types:** As above.

Asclepias concolor (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 6 [1896]. **Types:** As above.

Gomphocarpus scaber K. Schum., Bot. Jahrb. Syst. 17: 124 [1893], *non* Harv., Thes. Cap. 2: 58, T.192 [1863]. **Type:** *Fischer 399*, Kenya, Victoria Nyanza [Holo. B† Iso. K leaf & flower only. *n.v.*].

Gomphocarpus geminiflorus Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 31 [1895]. **Type:** *Schlechter 3669*, South Africa, Gauteng province, Magaliesberg, near the Apies River, occuring at foot of mountains, 7th Nov. 1893. 4800ft. (1463m) [Holo. B†].

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* Possibly now Yellowwood River

Asclepias geminiflora (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As for *G. geminiflorus*.

Gomphocarpus rhinophyllus K. Schum., in Engl. Pfl. Ost.-Afr. C:322 [1895, Aug.]; *nom nov.* for *G. scaber* K. Schum.

Gomphocarpus trachyphyllus K. Schum., in Engl. & Prantl., Pflanzenfam. 4(2): 237 [1895, Oct.], *nom nov.* for *G. scaber* K. Schum.

Discussion: N.E. Brown (1908) and Smith (1980 & 1988) treated *P. transvaalensis* as separate from *P. concolor*, however, since beginning the study of this family 18 years ago we have found it exceedingly difficult to separate *P. transvaalensis* from *P. concolor*. For this reason (and in order to adequately explain the variation of these taxa for the whole of Africa) Goyder (1998) sunk *P. transvaalensis* under *P. concolor*. However, he does go on to say that "... they could be recognized as subspecies if the corolla and corona colours noted on herbarium sheets are consistent." Although the flower color noted on herbarium sheets is more or less consistent it is not infalable for separating it from *P. concolor*. Despite this *P. transvaalensis* is on the whole distinct and, also, confined to an area centered around Swaziland and Mpumalanga. It, therefore, seems to be a genetic phenomenon worthy of some distinction, but not at the specific level. As a result, we have opted to treat it at varietal level. If this is done then it would seem that little can support the retention of *P. decorus* at specific rank. However, the pure white-colored flowers of this species immediately distinguishes it and suggests a different pollination syndrome. It also tends to maintain itself as distinct with little interbreeding with *P. concolor*. Because of this we have opted to continue to treat it at specific rank. The flowers of *P. concolor* are purple, pinky orange or maroon and yellow, but never white. These different taxa are dealt with in detail below rather than here. For the synonomy of this species in tropical Africa we have followed Goyder (1988). He has sunk *Pachycarpus rhinophyllus* of East Africa under *P. concolor*, giving this species a disjunct

distribution with a gap of over a thousand kilometers between the populations in Tanzania and those in Zimbabwe.

Distribution: African endemic. Southern Africa in Botswana, South Africa [Northern, North West, Gauteng, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] and Swaziland. Also in southern Mozambique, Zimbabwe, Tanzania and Kenya.

Key to Subspecies:

1a. Lower inflorescences pedunculate (10 to 60mm long)
rarely almost sessile ..... var. *transvaalensis*

1b. Lower inflorescences sessile or if 2 from the node then
1 sessile & 1 pedunculate ..... var. *concolor*

11a. *Pachycarpus concolor* E. Mey. variety. ***concolor***

Discussion: The range in leaf-shape is quite astounding, varying from broadly ovate to almost linear (distinct types often correlated with distribution), this contrasts strangely with the strong consistency in floral structure. The inflorescences are few-flowered, usually two (rarely one or three) and two inflorescences may occur at the same node, in which case one is shortly pedunculate and the other sessile; this is unique in the genus in southern Africa. The corona-lobes are slipper-like with the basal 2/3rds winged (these being swollen so that the margins of adjacent wings touch) and the apical part tapering, short to long and more or less erect (fig. 12). This widespread variety has about three distinct ecotypes; for details see Smith (1988). A form growing in the sandy soils of the Zululand coastal belt needs special mention. This ecotype has linear erect leaves in which the midrib dominates (fig. 12). It does not appear to hybridize with other ecotypes and is more or less parapatric, if not allopatric, with them. It may deserve some formal nomenclatural recognition at the infraspecific level. However, we have opted not to persue this route as Goyder (1989) points out that this same type of facie is found in east

African specimens. These east African specimens were originally placed in *P. rhinophyllus* by N.E. Brown, and according to Bullock (1954) have white flowers. In this they certainly differ from the Zululand ecotype which has a red corolla and yellow corona.

The Zulu name for this species is *ishongwe*. Plants are found in annually burned grasslands. This variety flowers from October to March, peaking November to January, rarely as late as April. Plants occur at altitudes of between 10 to 1700 meters. In tropical Africa occuring at 1300 to 2500 meters Illustrated in Anonymous (1926b), Smith (1980 & 1988), Goyder (1998) and Schill & Jakel (1978; pollinarium only).

Distribution: As for the species (fig. 13).

Conservation Status: Vulnerable to threatened in some areas only.

Representative Specimens: Botswana: *Marloth 1012*, Near Grootkuil [PRE]. **South Africa:** Northern: *Burtt Davy 2634*, Warmbaths [PRE]; *Smuts & Gillett 3351*, near Poort on Palala road [PRE]; *Galpin 513*, Waterberg [PRE]; *Breijer s.n.*, Minastone, Louis Trichardt [PRE 22049]; *Codd 2265*, near Nylstroom [PRE]; *Scheepers 1070*, Duiwelskloof [PRE]; *Bredenkamp 65*, Pietersburg Nature Reserve [PRE]. North West: *Pegler 1020*, Rustenberg [PRE, SAM]; *Collins s.n.*, Rustenburg [PRE 7019]; *Giffen 541A*, Mafeking [PRE]. Gauteng: *Codd 3481*, Haenertsburg west of Hammanskraal, Pretoria [PRE]; *Leendertzz 447*, Wonderboom Poort [PRE]; *Pole Evans s.n.*, Sjambok [PRE 51433]. Mpumalanga: *Thorncroft 1186*, Lomati Valley, Barberton [PRE]; *Breijer s.n.*, Nelspruit [PRE 17884]; *Jacobsen 1260*, Ohrigstad Dame Nature Reserve [PRE]; *Acocks 16663*, Shabin Kop, Kruger National Park [PRE]; *van der Schijff 174*, Pretorius Kop Camp [PRE flowers & fruit]. KwaZulu-Natal: *Nicholas 989,* Oribi Gorge district, Neethling's farm [NH, NU]. *Nicholas 1007*, Richmond [NH, NU]; *Nicholas 1026*, Howick north [NH, NU]; *Nicholas 1076,* Ngoye Forest [NH, NU]; *Nicholas 2789 with Poorun*, Vernon Crooks Nature Reserve [UDW]; *MacDevette 1327*, Weza State Forest [NH]; *MacDevette 2164*, Itala Nature Reserve [PRE]; *Edwards 388*, near Howick [NU];

Figure 12. *Pachycarpus concolor* var. *concolor*: a. & b. Showing different color variants; c. Coastal Zululand ecotype and; d. Close up of flowers of coastal Zululand ecotype. *P. concolor* var. *transvaalensis*: e. Flowering stem. *P. decorus*: f. Flowers. *P. lineolatus*: g. Flowering stem. Photographs: a by T. de Waal; b, e & f by M. von Fintel; c & d byA. Nicholas and; g by B. de Winter (de Winter 4120 PRE).

Balkwill & Cadman 2150, Vernon Crookes Nature Reserve [NU]; *Abbott 780*, Umtamvuna Nature Reserve [NH]; *Rudatis 1536*, Alexandra district [PRE]; *Stirton 456*, Ngoye Forest Reserve [PRE]; *Mogg 6070*, Melmoth [PRE]; *Williams 138*, Louwsburg mountain [NH]; *Coleman 276*, Hillcrest, Crestholme Nature Reserve [PRE]; *Ngwenya 488*, Winston Park [NH]; *Balkwill, Cadman & Boik 2433*, Weza State Forest [PRE]; *Wood 5681*, Ngoye [NH with drawing]; *Codd 9407*, Nqutu [PRE]; *Acocks 12255*, Arnold's Hill Station [PRE]; *Eshuis s.n.*, Inchanga [PRE 51479]; *MacDevette 1452*, Cedara State Forest [PRE]; *Wylie s.n.*, Greytown district [NH 22402]; *van Wyk & Venter 1278*, Oribi Gorge [PRE]. Eastern Cape: *Hutchings 151*, Umtata [NH, UNITRA]; *Acocks 20128*, Queenstown [PRE]; *Rogers 12800*, Dohne [NH]; *Galpin 1901*, Irebanya Mountain [PRE]; *Breijer 17192*, East London [PRE]; *Phillipson 1231*, Menziesberg [UFH specimen not typical]; *Acocks 9504*, Kubusie River valley [PRE]; *Comins 1371*, near Maclear Town [PRE]; *Hutchings 56*, Umtata [PRE not typical & corona-lobe wings very tall]. **Swaziland:** *Burtt Davy 3056*, near Bremmersdorp [NBG]; *Karsten s.n.*, Bulunga Poort, Manzini [PRE 31188].

Zululand Ecotype: *Nicholas 669*, Lake Quakwa [PRE]; *Nicholas 2153 with MacDevette*, Eastern Shores State Forest [CPF, NH]; *Venter 4425*, Manzengwenya [BLFU]; *Venter 9088*, between Mbazwana & Sibayi, near Nabazwana [BLFU]; *Balkwill 583*, near Kosi Bay [NU]; *Vährmeÿer & Tölken 275*, Lake Sabayi [PRE]; *Harrison 349*, Mtubatuba Nature Reserve [PRE]; *van Graan & Scwabe 1192*, Vasi Swamp [PRE]; *Moll 4729*, Vazi Swamp & Manzengwenya [PRE]; *Strey 4999*, Mpangazi lake [PRE]; *Prosser 1977*, Sodwana Bay [PRE]; *Vincent, Ward & Wells 13*, near Charters Creek [PRE]; *Ross & Moll 1838*, Kozi bay [PRE]; *Pienaar 881*, St Lucia [PRE]; *Phelan 808*, Manzengwenya [PRE]; *Strey 5075*, Mpangazi [PRE]; *Strey 5515*, Onkuduku [PRE].

11b. *Pachycarpus concolor* E. Mey. variety. ***transvaalensis*** (Schltr.) Nicholas. *Var. et Stat Nov.* **Type**: *Galpin 692b* (cited as 592b by Schlechter). South Africa, Mpumalanga Province, Saddleback Mountain near Barberton, Nov. 1889, 915—1372m [Holo B† Iso. K & SAM].

Gomphocarpus transvaalensis Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 19. (in note) & 22 [1894]. **Type:** As above.

Asclepias transvaalensis (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As above.

Pachycarpus transvaalensis (Schltr.) N.E. Br., in Fl. Trop. 4(1): 376 [1902]. **Type:** As above.

Gomphocarpus insignis Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 32 [1895]. **Type:** *Schlechter 3847*, South Africa, Mpumalanga, Elandspruitberg, on grassy mountain slopes, 3 Dec. 1893, alt. 7600ft. (= 2316m) [Holo B†].

Asclepias insignis (Schltr.)Schltr., in Journ. Bot.: 455 [1896]. **Type:** As for *G. insignis*.

Pachycarpus insignis (Schltr.) N.E. Br., in Fl. Cap. 4(1): 731 [1908]. Type: As for *G. insignis*.

Discussion: This variety is distinguished by its 2 to 4, sometimes 5-flowered inflorescences, and lower inflorescences pedunculate not sessile (fig. 12). However, this character is not always consistent and the occassional specimens of var. *concolor* (eg. Strey 5075 in NH) have the lower inflorescences pedunculate. Plants flower from October to December, peaking November. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. South Africa [Northern, Mpumalanga, KwaZulu-Natal (northern border region) provinces] and Swaziland (fig. 13).

Conservation Status: Very near being at risk, will certainly be so in the next century.

Representative Specimens: South Africa: Northern: *Onderstall 1280*, Tzaneen [PRE]; Leach 16652, Serala Milderness, Wolkberg [PRE]. Mpumalanga: *Rademacher 7493*,

Carolina [PRE]; *Onderstall 973*, Rustig farm, near Nelspruit [PRE]; *Rademacher s.n.*, Carolina [PRE 7493]; *Retief & Herman 32*, near Barberton [PRE]; *Rogers s.n.*, between Pilgrims Rest & Sabie [PRE 20724]; *Venter 11225*, Klipdraai [PRE]; *van der Merwe 20*, Wakkerstroom [PRE]; *Leendertzz (Potts) 35366*, Barberton [PRE]; *Galpin 1369*, Saddleback Mountain [PRE]; *Anderson A78*, de Kuilen farm, Lydenburg [PRE]; *Burtt Davy 7257*, Witklip [PRE]; *Buitendag 1024*, Uitkyk [PRE]; *de Souza 599*, Brommers farm, Barberton [PRE]; *Germishuizen 5717*, Songimvelo Game Reserve [PRE]. KwaZulu-Natal: *Strey 5057*, Mhangaji, Ubombo region [NH]; Nel 229, Bosveld plass, Pongola [PRE]. **Swaziland:** *Dlamini s.n.*, Melkerns [NBG]; *Ballance 132*, Malolotja Nature Reserve [PRE]; *Compton 51474*, Manzini [PRE]; *Braun 1807*, Malandzela [PRE]; *Brusse 4340*, Black Umbuluzi [PRE]; *Compton 31107*, Komati Pass [PRE].

12. *Pachycarpus decorus* N.E. Br., in Fl. Cap. 4(1): 732 [1908]. **Type**: *Barkly s.n.*, South Africa, Mpumalanga province, Endholeyana, near Piet Retief [Lecto. K 413].

Discussion: This species can be distinguished by its white, cream or yellowish-colored flowers and lowermost inflorescences pedunculate (fig. 12). Although florally similar to *P. concolor* we feel that the different flower color suggests a different pollinator and thus a degree of ethnological isolation. Hybridization does occur where *P. decorus* meets *P. concolor* (specimens cited below), but this is very limited. These hybrids have flowers that are white marked purple or maroon. On the whole *P. decorus* maintains its own unique gene pool and if sunk under *P. concolor* this information (which is important to conservationists interested in preserving as much of the genetic diversity of a species as possible) will be lost. As a result, we have not followed the sinking of this taxon into synonymy under *P. concolor*. As Smith (1988) points out this species can be confused with *P. scaber*, but the two differ completely in their vegetative features, inflorescences (in *P. scaber* they are corymbose, all being held at the same level on the plant, while in *P.*

decorus they are racemose, being ranked at different levels on the stems) and floral structure. In particular, *P. scaber* has corona-lobes differently structured, viz. with long thin apical tips that are inflexed and connivent over the center of the flower and quite different wing structure on the upper surface. Flowering occurs between November and December, rarely as late as January. Plants occur at altitudes of between 450 and 1800 meters. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. South Africa [Mpumalanga & northern KwaZulu-Natal provinces] and Swaziland (fig. 13).

Conservation Status: Very near being at risk, will certainly be so in the next century.

Representative Specimens: South Africa: Mpumalanga: *Acocks 13936*, Belfast [PRE]; *Gower s.n.*, Botsabelo [PRE 51416]; *Hilliard & Burtt 18437*, near Amsterdam on Piet Retief road [NU]. KwaZulu-Natal: *Galpin 9379*, Dumbeberg, Paulpietersburg [PRE]. **Swaziland:** *Pole Evans 3391*, Hluti [NH, PRE]; *Compton 26310*, Verdun [PRE]; *Compton 26456*, Mkondo [PRE]; *Compton 28315*, Ngudwane river [PRE]; *Compton 31951*, near Kubuta [PRE].

Possible Hybrids between P. decorus & P. concolor

Mpumalanga: *Onderstall 1095*, Rhenosterkop [PRE]; *Onderstall 1394*, Rhenosterkop [PRE]; *Venter 11225*, Klipdraai [PRE].

13. *Pachycarpus lineolatus* (Decne.) Bullock, in Kew Bull. 8: 333 [1953]. **Type**: *da Silva s.n.,* Angola [Holo P *n.v.* Photo. K].

Gomphocarpus lineolatus Decne., Ann. Sci. Nat. Bot. Sér. 2(9): 326 [1838]. **Type:** As above.

Asclepias lineolata (Dcene.) Schltr.,in Journ. Bot. 33: 336 [1838]. **Type:** As above.

Asclepias schweinfurthii N.E. Br., in Bull. Misc. Inform., Kew 1895: 253 [1895]. **Type:** *Schweinfurth 1960*, Sudan, Jur, 20 June 1869 [Holo. K *n.v.*].

Pachycarpus schweinfurthii (N.E. Br.) Bullock, in Kew Bull. 8: 330 [1953]. **Type:** As for *Asclepias schweinfurthii*.

Asclepias conspicua N.E. Br., in Bull. Misc. Inform., Kew 1895: 253 [1895]. **Type:** *Carson 12*, Zambia, Fwambo [Holo. K *n.v.*].

?*Calotropis busseana* K. Schum., in Bot. Jahrb. 33: 323 [1903]. **Type:** *Busse 341*, Tanzania, Usambara, 9 Sept. 1900 [Holo. B†].

Asclepias browniana S. Moore, in Journ. Bot. 47: 217 [1909]. **Type:** *Kässner 2806*, Congo, Lake Moero [Lecto. BM *n.v.*].

Pachycarpus mildbraedii Schlechter ex Bullock, in Kew Bull. 8: 334 [1953]. **Type:** *Mildbraedii 9391*, Cameroon, Bouar, May 1914 [Holo. K *n.v.*].

Discussion: This species is primarily a tropical African species and only just gets into southern Africa via northern Namibia. It is unfortunate, that the nomenclature and taxonomy of this species was so confused with that of *P. schweinfurthii* (now in synonomy) and *P. bisacculatus*. Fortunately, these problems were recently resolved by Goyder (1998) and we have followed his synonomy and circumscription here. *Pachycarpus mildbraedii*, with its more slender habit, narrowly lanceolate leaves, emarginate or bifid corona-lobe tip and narrowly fusiform follicles (Bullock 1954) may, however, deserve some sort of nomenclatural recognition. The only species in southern Africa with which *P. lineolatus* can be confused is *P. concolor*. *P. lineolatus* has a corona-lobe similar to *P. concolor* in that the wings on the upper surface are swollen fleshy confluent with the lobe and contiguous along their margin so that a sinus is formed between them (fig. 12). However, unlike *P. concolor* these swollen wings run the whole length of the lobe so that the lobe apex is not free and tapering in the upper 1/3 but rather more or less absent. The corona-lobe is white and purple in *P. lineolatus* rather than purple, maroon, yellow, light yellow or dull green as in *P. concolor*. Like *P. concolor* the

corolla is saucer-like, but differs in being white or cream with purple stripes. In *P. concolor* they are purple-brown, maroon, red, creamy yellow, green spotted purple or dull cream seldom stripped. Unlike *P.concolor* it also has inflorescences with long peduncles (20 to 170mm) while in *P. concolor* they are sessile or up to 60mm. *P. lineolatus* is also 4 to 12-flowered while *P. concolor* is usually 2-flowered rarely up to 5-flowered (fig. 12). For a summary of these and other differences see table 3.

Table 3. Showing the main differences between *Pachycarpus lineolatus* and *P. concolor*.

Characters	***P. lineolatus***	***P. concolor***
Stem height	0.4 to 1.5m	0.2 to 0.75(-1.0)m
Tubers	Fleshy, fusiform, fascicled & running horizontally	Narrow, cylindrical, solitary vertically & deep-seated
Leaf width	10 to 85mm	4 to 40mm
Peduncle length	20 to 170mm	0 to 60mm
Flower number	4 to 12	1 to 5
Upper corolla surface color	Cream to pale green usually marked with purple lines	purple-brown, maroon, red, creamy yellow, green spotted purple or dull cream seldom stripped
Corona-lobe length	7 to 8mm	5 to 14mm
Corona-lobe shape	With fleshy wings all the way to the apex which is, as a result, not tailed apically	With fleshy wings only in the basal half, leaving the apex free and tail- or tongue-like
Corona-lobe color	White to cream with a purple patch abaxially	Dull green to yellow sometimes with tips purple or dark purple throughout
Anther-wing length	2 to 3.8mm	2 to 5mm
Anther-appendage length	±1mm	1 to 3mm
Follicle shape	Usually ovoid, rarely fusiform	Fusiform

Southern African distribution	Namibia	South Africa (North West, Northern, Gauteng, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces) and Swaziland

According to information supplied by Dr Giles Balovale on a herbarium label in PRE, a piece of wood from this species is put into a fire, when hot sap emerges, this is taken and rubbed onto itching skin. He goes on to say that the Lovale/Lunda use the roots to catch birds. They sprinkle it (presumably powdered) amongst grain. Bird feeding on this become unconscious at which point they can be caught and then eaten. *P. lineolatus* is apparently found growing in open deciduous woodland or seasonally waterlogged grasslands, and occurs at altitudes of between 700 and 2500 meters (Goyder 1998). In southern Africa flowering from January to February. Illustrations can be found, as *Pachycarpus schweinfurthii*, in Bullock (1953) and Bruyns (1995), and, as *Pachycarpus lineolatus*, in Goyder 1998.

Distribution: African endemic. Southern Africa in northern Namibia only. Otherwise widespread in Africa. Occurring as far north as the Central African Republic, to the Côte d'Ivoire in West Africa and in central and East Africa. Absent from Mozambique, Zimbabwe, Botswana and South Africa (fig. 13)

Conservation Status: More common elsewhere in Africa, rare in southern Africa. As a result it must be considered at risk here.

Representative Specimens: Namibia: *de Winter 4120*, near Masari Experimental Station on road to Nyangana [PRE with photo.]; *Bruyns 5484*, Otavi [K *fide* Goyder (1998)]; *Strohbach 1268*, Tsumkew [WIND *fide* Bruyns (1995)].

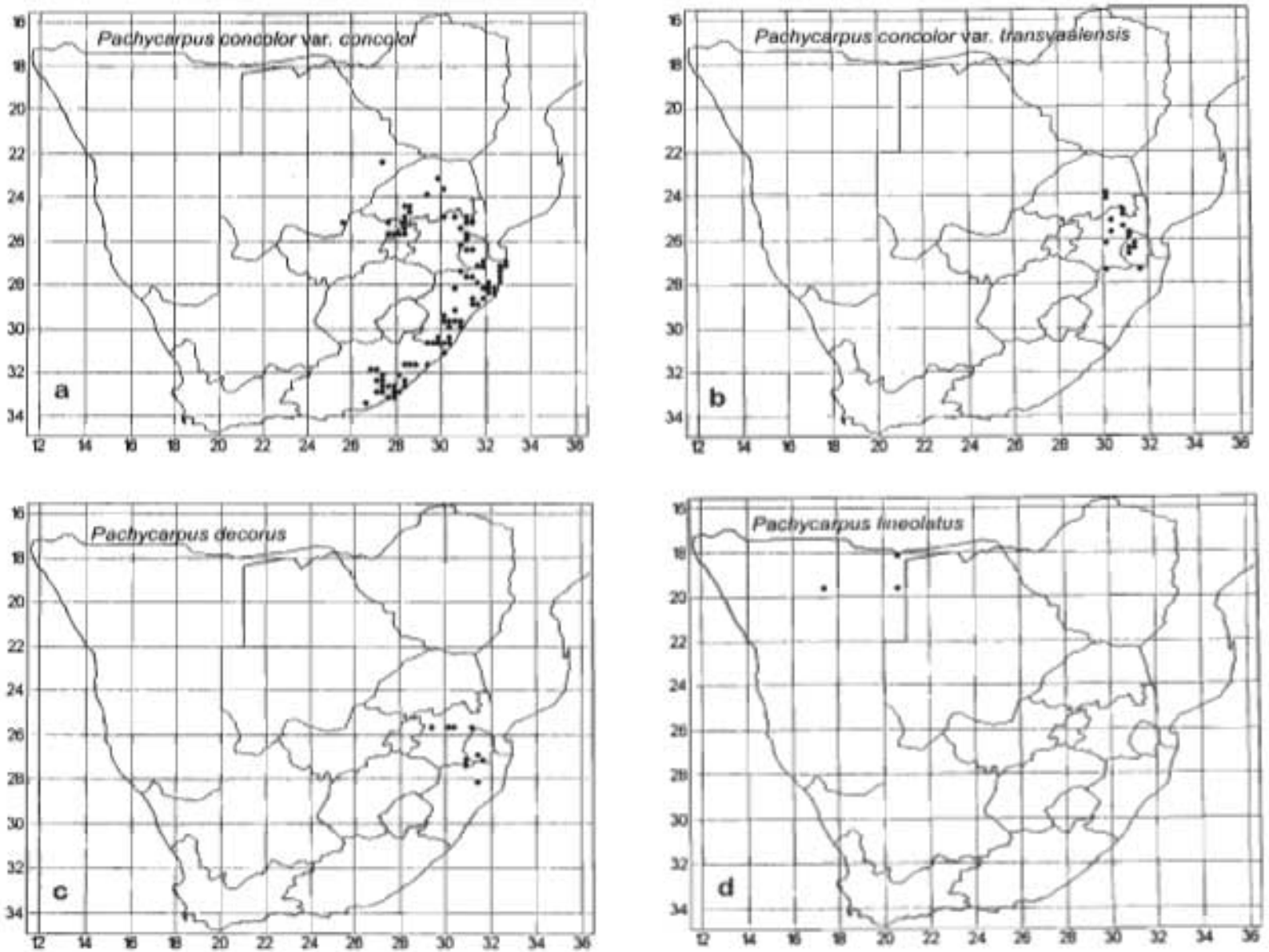

Figure 13. Distribution maps of: a. *Pachycarpus concolor* var. *concolor*; b. *P. concolor* var. *transvaalensis*; c. *P. decorus* and; d. *P. lineolatus*.

14. *Pachycarpus macrochilus* (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 376 [1902]. **Type**: *Flanagan 2067*, South Africa, Free State province, Bestersvlei near Witzieshoek, Jan. 1894, alt. 6500ft (= 1981m) [Lecto. PRE]. Selected here. *Bolus 8115,* South Africa, Free State province, Bestersvlei near Witzieshoek [Syn. B† Isosyn. K, BOL].

Asclepias macrochila Schltr., in Journ. Bot. 33: 355 [1895]. **Types:** As above.

Discussion: The corona-lobes of *P. macrochilus* are similar to some found in species of the basal group, but are much more ornate. The basal horizontal upper surface has two small wings that are highest near the gynostegial-column, the erect apical portion is dilated, large leaf-like and slightly inflexed. The basal part is also narrowed into a neck which may or may not have two small lateral teeth-like appendages. The flowers are also quite large with petals 16 to 28mm long. Flowering occurs from October to January and plants are found at altitudes of from 1700 to 2600 meters. This is one of the few asclepiad species common and widespread in the high altitude mountainous Kingdom of Lesotho. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. Lesotho and South Africa [Gauteng, Free State, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] (fig. 11).

Conservation Status: Vulnerable to threatened in some areas only. Largely protected by its occurrence at very high altitudes.

Representative Specimens: Lesotho: *Jacot Guillarmod 1911*, Monethi's [PRE]; *Theiler 143*, Bokong store [PRE]; *Stope 161*, Malutsinyane Valley, Maluti mountains [PRE]; *Schmitz 8568*, near Qiloane [PRE]; *Roux 1491*, Le Bihan waterfall [PRE]; *Dohse 299*, Mokhotleng [PRE]; *Gormley & Barber 40*, Ha Khotso [PRE]; *Dieterlen 377*, Sebothvane [PRE]; *Watt & Brandwyk 1840*, Thabaneng [PRE]; *Hoener 1651*, Sehlabathebe National Park [PRE]; *Jacot Guillarmod 3677*, Tsehlanyane Valley [PRE]; *Coetzee 475*, without precise locality [BLFU]. **South Africa:** Gauteng: *Gilliland s.n.*, Hartebeestfontein, south of Johannesburg [J26223]. Mpumalanga: *Henrici 289*, Nooitgedacht, Ermelo [PRE]; *Mogg 11377*, Nooitgedacht [PRE]; *Potts-Leendertzz 4895*, Goede Hoop, Ermelo [PRE];

Young A422, Boschhoek on eastern Steenkampsberg [PRE]. Free State: *Potts 3098*, Dunelm farm, Fouriesburg [BLFU, PRE]; *Gemmell s.n.*, Wynford [BLFU 7485]; *Jacobsz 173*, Rensburgkop, Swinburne [PRE]; *Kemp s.n.*, Verrkykerskop [BLFU 7479]; *Sankey 181*, Harrismith [PRE]; *Acocks 13169*, near Kestell [PRE]; *Blom 274*, Sterkfontein dam [PRE]. KwaZulu-Natal: *Barker 8020*, St. Bernard's mission [NBG]; *Wright 1569*, Kamberg [NU]; *Hilliard & Burtt 8681*, Royal Natal National Park [NU]; *Hilliard & Burtt 17094*, Gxalingenwa valley [PRE]; *Jacobsz 3930*, Loteni Nature Reserve [PRE]. Eastern Cape: *Bester 1970*, Maclear, Farm Glen Cairn [NH]; *Strever 526*, Qachasnek [PRE]; *Acocks 12188*, Scraptaft, Maclear district [PRE]; *Granger 3543*, Marshall Clarke, Thaba Chitja district [PRE]; *Stewart 1932*, Naudes Nek, Maclear [NU].

15. *Pachycarpus plicatus* N.E. Br., in Fl. Cap. 4(1): 724 [1908]. **Type**: *Wood 4801*, South Africa, KwaZulu-Natal province, Buffalo River valley near Charlestown [Lecto. K; Isolecto. NH]. Selected here. *Clarke s.n.*, South Africa, KwaZulu-Natal province, Ixopo division, hillside at Rock Fontain [Syn. *n.v.*]; *Tyson s.n.*, South Africa, Eastern Cape province, near Kokstad [Syn. BM ex BOL *n.v.*] Apparently mixed with *Pachycarpus dealbatus*.

Discussion: *P. plicatus* resembles *P. natalensis* and *P. macrochilus*, but differing from both in its anther-wing and corona-lobe structure, and from *P. natalensis* by it yellow and brown flowers. The corona-lobes of *P. plicatus* is a natural progression from those in *P. macrochilus*, becoming more reflexed at the tips and spreading laterally in the basal horizontal section rather than toothed and erect (fig. 14). Interestingly the type collection is isolated in the north of KwaZulu-Natal; all subsequent specimens have been collected much further south. In this species the anther-wings are subhorizontal rather than almost vertical, this is the only species of *Pachycarpus* to exhibit this. Plants occur in rocky grassveld, where the rocks give them some protection from fire and to an extent also

grazing. Flowering occurs from October to January, and plants are found at altitudes of between 760 and 1100 meters, rarely as high as 2200 meters. Illustrated in Smith (1980 & 1988).

Distribution: South African endemic [Eastern Cape (eastern border region) & KwaZulu-Natal (Drakensberg & foothills) provinces] (fig. 17).

Conservation Status: Low Risk (Least Concern). Vulnerable to threatened in many areas.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 2731 & 2734 both with Poorun*, Sunset farm, Underberg district [UDW]; *Killick & Varhmeÿer 3699*, Upper Umkomaas [NH, PRE]; *Kok & Pienaar 1203*, near Middle Rest [PRE]; *Werdermann & Oberdieck 1224*, Estcout district [PRE]; *West 1561*, Estcourt Research Station [NH]; *Green 352*, Lowlands valley [NH]; *Abbott 4557*, Weza State Forest [NH]; *Solomon s.n.*, Castle Garden [NU]; *Wood 4501*, Charlestown [NH with drawing]; *Acocks 10681*, Griffin's Hill [NH]; *Hilliard & Burtt 15770*, Upper Mkomazi river [PRE]. Eastern Cape: *Acocks 12223*, Bizana commonage [PRE]; *Hilliard & Burtt 7665*, Weza, Zuurberg [NU].

16. *Pachycarpus natalensis* N.E. Br., in Fl. Cap. 4(1): 724 [1908]. **Type**: *Fannin 35*, South Africa, KwaZulu-Natal province, Dargle [Lecto. K. Isolecto. PRE, TCD] (fig. 15). *Fry H2744*, South Africa, KwaZulu-Natal province, Greenwich farm, Riet Vlei [Syn. K photo NU. Isosyn PRE]; *Wood 470*, South Africa, KwaZulu-Natal province, Inanda [Syn. K photo NU. Isosyn. NH stem and leaves only]; *Wood 1420*, South Africa, KwaZulu-Natal Province, Inanda [Syn. *n.v.*]; *Wood 6641*, South Africa, KwaZulu-Natal Province, Intshanga [Syn. *n.v.*].

Discussion: The corona-lobes of this species also follow on naturally from those of *P. macrochilus*, the upper leaf-like portion is reflexed and connivent over the gynostegial-column (forming a close cage around it). The narrow corona-lobe neck is shorter, rather

than long (as in *P. macrochilus*), and the two basal teeth have become large. In its corona-lobe structure it is somewhat similar to *P. reflectens*; differences are discussed under that species (fig. 15). This is primarily a Natal species with the bulk of specimens so far collected from this area. Flowering occurs from October to February and plants are found at altitudes of between 760 and 1150 meters. Illustrated in Smith (1980 & 1988).

Distribution: South African endemic [KwaZulu-Natal (southern half) & Eastern Cape (northern part) provinces] (fig. 17). The range of distribution has been extended since Smith's 1988 revision.

Conservation Status: Low Risk (Least Concern) following Scott-Shaw (1999). Occurring in areas that are not only heavily populated but also succumbing to ever increasing agriculture and afforestation.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 924*, World's View, Pietermaritzburg [CPF]; *Nicholas 951*, between Mooiriver & Estcourt [NH]; *Nicholas 1000 with Nicholas DC.*, Ixopo area [CPF, NH]; *Nicholas 1030*, Howick North [CPF, NH, NU]; *Edwards 691*, near Highflats [NU]; *Green 464*, Curry's Post at Lions River turn off [NH]; *Wood 11214*, near Howick [NH with drawings]; *Edwards 1261*, Wahroonga farm, Merrivale [NU]; *Strey 4421*, Highflats, Umzinto [NH, PRE]; *Harriss 76*, Pietermaritzburg [NU]; *Harriss 114*, World's View [NU]; *Harriss 105*, Fort Nottingham Commonage [NU with stem-tuber]; *Ngwenya 50*, outside Greytown [NH with part of stem-tuber]; *Moll 2636*, Pietermaritzburg [PRE]; *Wood 6178*, Lidgetton [PRE]; *Haygarth 22301*, Krantzkloof [PRE]; *Strey 51626*, Inanda [PRE]; *Greene 336*, Mooi River [NH]; *Schrire 709*, Kunhardt's farm, near Merrivale on road to Boston [NH]; *Acocks 13878*, near Nottingham Road [PRE]; *Dyer 4273*, near Pietermaritzburg on Richmond road [PRE]; *Dyer 4866*, between Nottingham Road & Balgowan [PRE]; *Dohoe, Lansdell & Shephard 33*, Winston Park, Kloof [NH]; *Oliver 6761*, near Boscombe Estate, Ahrens [PRE]. Eastern Cape: *Hutchings 1330*, Flagstaff, between Tabankulu & Gomo Forest [NH]; *Hutchings 152*, Umtata [NH].

Figure 14. *Pachycarpus plicatus*: a. Whole plant showing habit & habitat (150mm tall); b. Close up of flower and; c. Flowers with visiting African Monarch butterfly and Hemipteran bugs (these latter indicated with arrows). Photographs by A. Nicholas.

17. *Pachycarpus reflectens* E. Mey., Comm. Pl. Afr. Austr.: 210 [1838]. **Types**: *Drège 4934,* South Africa, Eastern Cape province, near Gekau* [Lecto. K]. *Drège s.n. (V, b),* South Africa, Eastern Cape province, between Kachu & Komga, alt. 1000—300ft (= 304—914m) [Sy. *n.v.*].

Xysmalobium reflectens (E. Mey.) Dietr., Syn. Pl.: 902 [1840]. **Type:** As above.

Gomphocarpus reflectens (E. Mey.) Decne., in DC. Prodr. 2: 563 [1844]. **Type:** As above.

Asclepias reflectens (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Type:** As above

Pachycarpus reflexus, in error, Steud. Nom. Bot. 2 edn.: 245 [1841]. **Type:** As above.

Discussion: This species sits with *P. macrochilus* & *P. natalensis* in a group and may be confused with the latter species when preserved as herbarium specimens, however, this confusion is unlikely to happen in the field because both species are quite distinctive. The leaves of *P. natalensis* are broadly elliptic to slightly orbicular (23 to 47mm wide), with the veins prominent right down to the tertiary level. In *P. reflectens* leaves are lanceolate to narrowly oblong (12 to 28mm wide), with veins not as prominent especially at the tertiary level. The corolla of *P. reflectens* is strongly reflexed (usually lying back along the pedicel) and the margins revolute or strongly revolute for their entire length (fig. 16). In *P. natalensis* the corolla is saucer-like with petals spreading and the margins only slightly revolute near the apex. The corona-lobes in the two species are similar in structure with the apical leaf-like half connivent over the gynostegial-column. However, there are differences and these can be found in Smith (1988). In the protologue, Meyer (1838) cites two Drège specimens. The one chosen by Smith (1988) as the lectotype (housed at K) is said to be collected near Gekau (Gena) river, but according to Meyer this

* Near present day Butterworth (Gunn & Codd, 1981).

Figure 15. *Pachycarpus natalensis*: a. & b. Flowering stems; c. Isotype Fannin 35 (TCD) and; d. Close up of flowers. Photographs: a & d by A. Nicholas; b by M. von Fintel and; c by Kew Photographer.

was collected between the Fish and Kap Rivers in the Bathurst Division. According to N.E. Brown (1908) they are the same specimen and the difference in localities is an error. *P. reflectens* flowers November to January and plants occur at altitudes of between 200 and 1400 meters. Illustrated in Smith (1980 & 1988).

Distribution: South African endemic [Eastern Cape province only] (fig. 17).

Conservation Status: Low Risk (Near Threatened). This species occurs in an area that has seen widespread environmental abuse and in which the grazing of once protected road reserves has lead to these previously species rich environments (especially for Asclepiadaceae) to become barren and pauperized.

Representative Specimens: South Africa: Eastern Cape: *Nicholas 2801 with DC Nicholas*, Gubu Dam [UDW]; *Bester 2074*, Farm Cathgarva, Elliot [NH]; *Flanagan 16,* near Kei River [GRA, NH]; *Galpin 1712*, Katberg, Stockenstroom Division [K, PRE]; *Compton 17766*, Mooi Plaas near East London [NBG]; *Batten 105*, Komga [PRE]; *Arnold ex Galpin 5836*, Amalinda [PRE]; *Acocks 2549*, East London [PRE]; *Acocks 10975*, Butterworth [PRE]; *Acocks 20261*, near Dohne Research Station [PRE]; *Bowker s.n.*, Kreilis Country [PRE 14447]; *Hilliard & Burtt 11104*, near Komga [NU].

18. *Pachycarpus appendiculatus* E. Mey., Comm. Pl. Afr. Austr.: 210 [1937]. **Type**: *Drège 4933,* South Africa, Eastern Cape province, in flat burnt grassland between Morley and Umtata, near Morley, 457—610m [Holo. B† Iso. K photo NU].

Xysmalobium appendiculatum (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above.

Gomphocarpus appendiculatus (E. Mey.) Decne., in DC. Prodr. 8: 562 [1844]. **Type:** As above.

Asclepias appendiculata (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 5 [1896]. **Type:** As above.

Gomphocarpus macroglossus Turcz., in Bull. Soc. Nat. Moscou. 21(1): 259—260 [1848]. **Type:** *Ecklon 34,* South Africa, Eastern Cape province, Bathurst Division, hills near the Great Fish River between Drift and Governor's Kop [Lecto. MEL]. Lectotypified by Forster (1994).

Discussion: With its reflexed, albeit not as strongly, corolla and the same overall corona-lobe gestalt this species resembles *P. reflectens*. However, the leaf shape and corona-lobe structure differ greatly from each other in the northern part of the range of *P. appendiculatus*, but not so in the south where *P. reflectens* and *P. appendiculatus* are sympatric. Despite this, the two species are still easily separable; see the differences outlined in Smith (1988). In *P. appendiculatus* the apical, dilated, leaf-like, erect portion of the corona-lobe is usually quite ornate with margins undulate or crenulate and with a longish, narrowed apical appendage; hence the specific epithet (fig. 16). The leaves of this species in shape, texture and venation are very similar to *Parapodiopsis orbiculare*, while the semiglobose follicles show some connection to the fruits of *P. asperifolius*, *P. scaber and Pachycarpus confusus* of subgenus *Parapodiopsis*. This species flowers between October and January, rarely as late as March and plants occur at altitudes of between 140 and 1000 meters. Illustrated in Smith (1980 & 1988).

Distribution: Southern African endemic. South Africa [Mpumalanga, KwaZulu-Natal (but more or less absent from the southern half) and Eastern Cape provinces] and Swaziland (fig. 17).

Conservation Status: Vulnerable to threatened in some areas only.

Representative Specimens: South Africa: Mpumalanga: *Pott 5241*, Spitzkop, Ermelo [PRE]. KwaZulu-Natal: *Nicholas 1760 with van den Berg,* Vryheid district, near Bevenson [CPF, NH, PRE]; *Venter 5199*, Mkuzi bridge, Ubombo [BLFU]; *Williams 304*, Babanago, Goudhoek farm [NH]; *Harriss 125*, Lebombo Mountains near Josini [NU]; *Eshuis 39*, Inchanga [PRE]; *Kok & Pienaar 1271*, KwaNdululu Clinic [PRE]; *MacDevette 2128*, Itala Nature Reserve [PRE]; *Hitchins 239*, Hluhluwe Game Reserve

Figure 16. *Pachycarpus macrochilus*: a. Whole plant showing habit (*circa* 150mm). *P. reflexus*: b. Whole plant showing habit (200mm tall). *P. appendiculatus*: c. Flowering stem and; d. Follicle. e. Habitat of *P. lebomboensis* near Mkuzi in the KwaZulu-Natal province. f. Habitat of *P. stenoglossus*. Joubert Pass near the Winterberg in the Eastern Cape province. Photographs: a, c & d by M. von Fintel and; b, e & f by A. Nicholas.

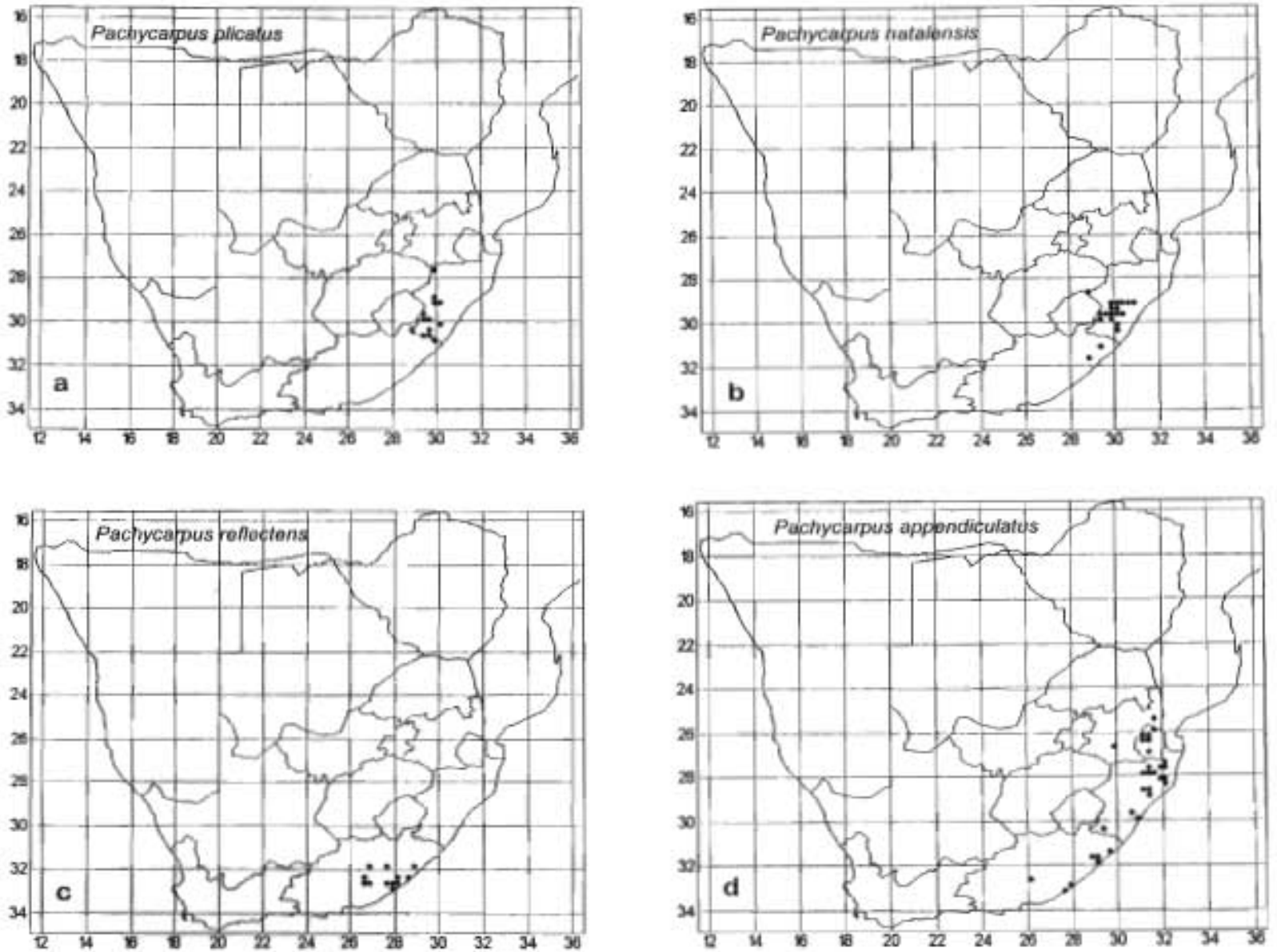

Figure 17. Distribution maps of: a. *Pachycarpus plicatus*; b. *P. natalensis*; c. *P. reflectens* and; d. *P. appendiculatus*.

[PRE]; *Gerstner 5210*, Ngome [PRE]; *Harriss 119*, near Hlabisa on Nongoma road [NU fruit]; *Gerstner 744*, Benedictene Mission, Nongoma [PRE]; *Acocks 13078*, near Hlabisa [PRE]; *Wood 10839*, Entumeni [PRE]; *Wylie ex Wood 10832*, Somkele [NH with drawing]; *Strey 4636*, Mkusi [NH, PRE]; *Tölken & Germishuizen 5793*, near Josini [PRE]; *Ward 1630*, Hluhluwe Game Reserve [PRE]; *Schrire 1322*, Paulpetersburg [NH]. Eastern Cape: *Cloete 1765*, Umtata, Unitra campus [NH]; *Wood 23*, East London [PRE]; *McLoughlin 4729*, Umtata [PRE]; *McLoughlin 51528*, Kokstad [PRE]; *Pegler 571*, Umtata [PRE]. **Swaziland:** *Compton 31323*, Mhlope, Hlatikulu [NBG, PRE]; *Burtt Davy 3056*, Bremmersdorp [PRE]; *Culverwell 1203*, Blue Jay Ranch, Mbuluzi Gorge [PRE]; *Karsten s.n.*, Komati Pass [NH 111016]; *Codd 4752*, without precise locality [PRE]

19. *Pachycarpus scaber* (Harv.) N.E. Br., in Fl. Trop. Afr. 4(1): 377 [1902]. **Type**: *Gerrard & McKen 1285,* South Africa, KwaZulu-Natal Province, Zululand [Holo. TCD. Iso. K photo NU].

Gomphocarpus scaber Harv., Thes. Cap. 2: 58 & t.192 [1863]. **Type:** As above.

Asclepias scabra (Harv.) Schltr., in Journ. Bot. 34: 454 [1896]. **Type:** As above.

Discussion: This species is very distinctive within the genus (Smith, 1988), but despite or maybe because of this it is difficult to decided where it fits phylogenetically within the genus. Sometimes the leaves are almost *Xysmalobium* like, which along with the inflated fruit suggest a basal position, however, the corona is too complicated (therefore derived) to place it with the basal group. Besides *P. schinzianus* and *P. decorus,* it is the only other southern African *Pachycarpus* species with white flowers (fig. 18). However, it differs from *P. decorus* vegetatively, in its inflorescences, florally and in its fruit; see Smith 1980 for further differences. From *P. schinzianus* it differs florally, in its corona-lobe structure and fruit. As a result, it is unlikely to be related to either of these taxa. Because it is vegetatively similar (has the corolla spreading reflexed and the apical portion of the

corona-lobe inflexed and connivent over the gynostegial-column), we have, thus, opted to place it near *P. appendiculatus* and allies. In particular, we have also placed it near *P. asperifolius* because, in common with this species, it has large, inflated globose follicles similar to *Pachycarpus confusus* of subgenus *Parapodiopsis*; albeit this character may prove to be homoplasious. However, despite all these characters the flower color is quite anomalous to *P. appendiculatus*, and *P. asperifolius* and allies. *P. scaber* flowers from October to January, seldom as late as March. Plants occur at altitudes of between 750 and 1850 meters. Illustrated in Wood (1912); Smith (1980 & 1988)

Distribution: Southern African endemic. South Africa [Mpumalanga, Free State, KwaZulu-Natal (border with Natal only) & Eastern Cape provinces] and Swaziland (fig. 19).

Conservation Status: This is one of the few *Pachycarpus* species that can be found growing, almost weedy, along road sides. Despite this weedy propensity, since this study was first initiated in 1980, *P. scaber* seems to be encountered less and less as the years have gone by. Only threatened and vulnerable in some areas.

Representative Specimens: South Africa: Mpumalanga: *Anderson 92*, de Kuilen farm, near Lydenburg [PRE]; *Jacobsen 1259*, Ohrigstad Dam Nature Reserve [PRE]; *Meyer 110*, Songimvelo Game Reserve [PRE]; *Potts-Leendertzz 4897*, Spitskop, Ermelo [PRE]; *Sidey 2049*, Piet Retief district [PRE]. *Thorncroft 433*, Montrose hills, near Barberton [NH]. KwaZulu-Natal: *Nicholas 957*, between Colenso to Ladysmith [NH, NU]. *Nicholas 1762 with van den Berg,* Vryheid district, near Bevenson [CPF, NH]; *Franks s.n., sub Wood 11716*, Camperdown [NH 13016 with drawing]; *MacDevette 1444*, Cedara State Forest [NH]; *Harriss 84*, between Richmond & Pietermaritzburg [NU]; *Harriss 170*, Mpophomeni [NU fruit]; *Wylie s.n.*, Greytown district [NH 22360, PRE ex NH 22360]; *Wood 6160*, Van Reenen [PRE]; *Strey 5161*, Beacon Hill, Inanda [Pre]; *Werdermann & Oberdieck 1336*, Helpmekaar [PRE]; *Williams 292*, Goudhoek farm Babanongo [PRE]; *Williams 417*, Ahrens [NH]; *Green 475*, Kempton [NH]; *King 328*, Vryheid [PRE];

Acocks 11839, Thornville [PRE]; *Codd 1967*, near Dwarsrand [PRE]; *Codd 9408*, near Nqutu [PRE]; *Dyer 4274*, near Pietermaritzburg [PRE]; *Germishuizen 2178*, near Kongolwane [PRE]; *Schrire 1127*, between Kongolane & Louwsburg [NH]; *Kok & Pienaar 1273*, near Paulpietersburg [PRE]; *Fry s.n.*, Greenwich farm, Reit Vlei [PRE 2745]; *Jacobsz 1774*, Boschfontein, near Brakwalstasie [PRE]. Eastern Cape: *Tyson 2165*, Clydesdale [PRE]. **Swaziland:** *Compton 30351*, Commisie Nek [NBG, NH, PRE]; *Compton 29530*, Mkondo river [NH]; *Codd 4752*, near Mbabane [PRE]; *Compton 28311*, Ngudwane river [PRE]; *Compton 6136*, Komati river, Hhohho district [PRE]; *Hobson 2161*, near Enkaba mountain [PRE].

20. *Pachycarpus asperifolius* Meisn., in Journ. Bot. 2: 544 [1843]. **Type**: *Krauss s.n.*, South Africa, KwaZulu-Natal province, margin of woods around Durban Bay [Holo. NY].

Gomphocarpus validus Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 20 [1894]. **Type:** *Galpin 707*, South Africa, Mpumalanga province, grassy slopes at base of mountains between Barberton and Avoca, 600—850m, between November & December 1889 [Holo. K. Iso. NH, PRE, SAM].

Asclepias valida (Schltr.) Schltr., in Journ. Bot. 34: 455 [1896]. **Type:** As for *Gomphocarpus validus*.

Pachycarpus validus (Schltr.) N.E. Br., in Fl. Trop. Afr. 4(1): 377 [1902]. **Type:** As for *Gomphocarpus validus*.

Pachycarpus inconstans N.E. Br., Fl. Cap. 4(1): 722 [1908]. **Type:** *Krauss 83*, South Africa, KwaZulu-Natal province, at margins of the woods near Durban Bay [Lecto. K. Isolecto. PRE]. *Flanagan 757*, South Africa, Eastern Cape province, hills near Kei mouth [Syn. *n.v.*]; *Bowker s.n.*, South Africa, Eastern Cape province, Kreilis Country [Syn. *n.v.*]; *Flanagan s.n.*, South Africa, Eastern Cape province, Pondoland, hills near

Port St. Johns [BOL 10205 *n.v. fide* N.E. Brown 1908]; *Galpin 3195*, South Africa, Eastern Cape province, Pondoland, hills near Port St. Johns [Syn. *n.v.*]; *Galpin 3196*, South Africa, Eastern Cape province, Pondoland, hills near Port St. Johns [Syn. *n.v.*]; *Galpin 3445*, South Africa, Eastern Cape province, Pondoland, hills near Port St. Johns [Syn. K. Isosyn PRE]; *Wood 1075*, South Africa, KwaZulu-Natal province, Inanda [Syn. *n.v.*]; Krauss 83, South Africa, KwaZulu-Natal, at the margin of woods near Durban Bay [Syn. K. Isosyn. PRE].

Pachycarpus concolor sensu Meisn., in Journ. Bot. 2: 544 [1843].

Discussion: Like *P. scaber* and *P. confusus* of subgenus *Parapodiopsis* this species has large inflated globose fruits (fig. 18). The leaves are similar to *P. appendiculatus, Parapodiopsis orbiculare* and to an extent the genus *Parapodium*. In fact, in its general facie it is very similar to species of subgenus *Parapodiopsis* and should probably be placed near the begining of our phylogenetic series. The corona-lobes are, however, quite different to anything else in the genus *Pachycarpus*. They are small and more or less blob-like, as in some species previously placed in the genus *Xysmalobium*, differing from these only in a central sinus that runs down the middle (fig. 19). However, as pointed out by Smith (1980), in a number of specimens the corona-lobes are shortly slipper-shaped, almost like a very small version of *P. concolor*, but with or without the apical part slightly extended as in that species. Possibly a case could be made for according these (more slipper-shaped as opposed to globose shaped corona-lobed) specimens infraspecific status. However, any resemblance to *P. concolor* is probably coincidental as this species seems more closely allied to *P. appendiculatus* and allies. All this, despite the very reduced corona-lobes, places it firmly in *Pachycarpus*. Plants occur on rocky grassy hillsides. *P. asperifolius* flowers from October to March, peaking November to March. Plants occur at altitudes of between 60 and 1700 meters. Illustrated in Smith (1980 & 1988).

Distribution: South African endemic [Northern, Gauteng, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] (fig. 19).

Conservation Status: Vulnerable to threatened in some areas only.

Representative Specimens: South Africa: Northern: *Rogers 18142*, Zoutpansberg, Louis Trichardt [J, NH]; *McCallum 136*, Pietersburg district [PRE]; *Obermeyer s.n.*, Elim [PRE 29281]; *Schlieben & Strey 8292*, Louis Trichard [PRE]; *Bremekamp & Schweickerdt 352*, Funduzi, Zoutpansberg [PRE]; *Junod s.n.*, Shiluvane [PRE 10207]; *Junod s.n.*, Sibasa [PRE 21200]. Gauteng: *Smith 3539*, Pretoria district [PRE]; *Smith 3469*, Trichards Poort [PRE]. Mpumalanga: *Galpin 707*, between Barberton & Avoca [K, NH, PRE, SAM]; *Barnard & Mogg 990*, Lulu mountains, Sekukuniland [PRE]; *Codd & de Winter 3280*, near Sabie [PRE]; *Codd 6669*, near Lydenburg [PRE]; *Dreyer 397*, Songimvelo Game Reserve [PRE]; *Galpin 13004*, Machadodorp [PRE]; *Galpin 14633*, Blyde River Gorge [PRE]; *Smuts & Gillett 2212*, Somerset farm, Schoemans Kloof [PRE]; *Stalmans 909*, Lekgalameetse Nature Reserve [PRE]; *Watt & Brandwijk 1772*, Barberton [PRE]; *Story 544*, Shebam Mine [PRE]; *Kluge 650*, Witklip [PRE]; *Kok & Pienaar 1293*, between Barberton & Badplaas [PRE]; *Leach, Barnett, Bayliss & Giess 16653*, Serala Wilderness [PRE]; *Onderstall 27NS7*, Uitkyk [PRE]; *Jenkins s.n.*, Middelburg [PRE 9510]. KwaZulu-Natal: *Sikhakhane 7*, Matabethule Plateau, Inanda [NH]; *Nicholas 986*, Oribi Gorge National Park [NH, NU]; *Nicholas 1758 with van den Berg*, near Indundulu Mountain [CPF, NH]; *Nicholas 2711 with Poorun*, Westville, Durban [UDW]; *Nicholas 2737*, Westville, Durban [UDW]; *Williams 70*, Verulam Nature Reserve [NH]; *Gafney 9*, Table Mountain nature Reserve [PRE]; *Harriss 82*, Foxhill between Richmond & Pietermaritzburg [NU]; *Harriss 113*, Kloof [NU]; *Wood 12000*, Camperdown [PRE]; *Stirton 523*, Umlaas Road [PRE]; *Franks ex Wood 11081*, Camperdown [NH]; *Wood s.n.*, Springfield [PRE 59093]; *Wood 1075*, Inanda [NH with drawing]; *Abbott 2242*, Umtamvuna Nature Reserve [NH]; *Balkwill & Cadman 2139*, Vernon Crookes Nature Reserve [PRE]; *Strey 6151*, Izotscha [NH, NU, PRE]; *Strey*

Figure 18. *Pachycarpus scaber*: a. Whole plant showing habit (*circa* 500mm tall); b. Flowering stem; c. Close up of flowers and; d. Holotype Gerrard & McKen 1285 (TCD). *P. asperifolius*: e. Flowering stem; f. Inflated semiglobose follicles; g. Whole plant showing fleshy, narrowly cylindrical, deep-seated stem-tuber, indicated with an arrow and; h. Close up of flowers. Photographs: a by L. Greene, b, c & f to h by A. Nicholas; d by Kew Photographer and; e by T. Abbott.

9304, New Germany [NH, PRE]; *Sikhakhane 7*, Inanda [NH]; *Strey 11298*, Richards Bay [PRE]; *Ward 6380*, Stainbank Nature Reserve [NH with flowers & fruit, PRE]; *van Wyk & Venter 1278*, Aurora farm, Oribi Gorge [PRE]. Eastern Cape: *Nicholas 2352 with Smook & Harrison,* Mkambati Nature Reserve [NH, PRE]; *A & G Hutchings 2054 with Plumstead*, Mt. Thesiger [NH]; *Gordon-Gray 1003*, The Haven [NU]; *McLoughlin 5339*, West Gate, Port St. Johns [PRE]; *Dyer 4518*, Manubi forest, near Mazeppa Bay [PRE]; *Galpin 5795*, Rooi Wal river mouth [PRE]; *Galpin 10942*, Ngogwana river falls [PRE]. **Swaziland:** *Karsten s.n.*, Komati Pass [PRE].

PACHYCARPUS* E. Mey. SUBGENUS *PARAPODIOPSIS Bullock ex Nicholas *subgen. nov.* ***Habitus*** *perennis, geophyticus, cum latice.* ***Oragnum-subterraneus*** *tubera caulie napiformis.* ***Caulis*** *crassus, erectus, 0.3—1.3m elatus.* ***Folio*** *lamina ovato ad latus elliptico, coriaceus, 40—140mm longo, 10—70mm latus, margine plano, nervatura prominens. Inflorescentia globoso, umbelliformis; pedunculis crassus, 0—32mm longo.* ***Floris*** *cupulis-rotataus ad reflexus.* ***Corolla*** *ad basis divisus; lobus 5.5—12.5 mm longus, 3—8 mm latus.* ***Staminalis coronae*** *ad gynostegio-columna basim exorientia, lobi discretus, erectus, complanatus dorso-ventralis, obovatis ad suborbicularis, squamiformis, 1.5—4.5mm longus, 2.2—5mm latus.* ***Folliculi*** *obovoideus, 30—96mm longus, 12—53mm latus.* **TYPUS:** *Parapodiopsis orbiculare* (E. Mey.) Stewart & Langley ex Nicholas, *vide infra*.

Parapodiopsis Bullock ex Stewart & Langley not effectively published.

Description: *Habit*: herbs. *Underground organ* a turnip-shaped stem-tuber. *Stems* solitary or up to 3, stout, erect, usually unbranched, rarely branched, 0.3—1.3m tall, 8—11mm wide, sometimes internodes shorter below, longer above, bifariously hairy especially nearer the apex, rarely glabrous, purple-brown colored near the base. *Leaves* 7—11 pairs per stem, subsessile to petiolate, sometimes crowded at the stem base, longer

than the internodes; lamina coriaceous, ovate to broadly elliptic, rarely obovate or lanceolate, 40—140mm long, 10—70mm wide, apex usually obtuse, sometimes emarginate to acute, always mucronate, base broadly subcordate, round to cuneate, margins entire, flat & scabrid, all levels of venation prominent, adaxial & abaxial surfaces glabrous to glabrate; petiole 2—12mm long. *Inflorescences* 12—16 per plant, sessile or pedunculate, umbel-like, globose, produced close together, 10—48-flowered; peduncles stout, sessile or up to 32mm long; bracts subulate, pubescent, 3—32mm long, 1.5—2.5mm wide. *Flowers* ±8mm wide, cupulate-rotate to reflexed, pedicellate; pedicels 9.5—25.0mm long. *Calyx lobes* linear, lanceolate to ovate, 3.0—9.5mm long, 1.0—2.8mm wide, glabrous to sparsely pubescent, margins pubescent. *Corolla* spreading erect to reflexed when mature, divided almost to the base; lobes narrowly ovate, oblong-ovate to elliptic, 5.5—12.5mm long, 3—8mm wide, apex acute with a small symmetrical or oblique notch, margins revolute, yellowish-green, greenish-white, brownish, or slightly red or white, green veined & marked with dull red, base with a green blotch, margins brownish-purple. *Staminal-corona* arising at the gynostegial-column base & closely apressed to it; lobes free, erect, dorso-ventrally flattened, obovate to suborbicular, scale-like, 1.5—4.5mm long, 2.2—5.0mm wide, fleshy, apex obtuse & incurved, cuneate towards the base, margins thickened & slightly inflexed, inner surface obtusely keeled near the apex, with or without a small protrusion or lobule near the base, outer surface convex, not reaching the style-apex by 0.5—2.0mm, white, greenish-white or greenish yellow. *Staminal-column* stout or constricted under the anther-wings, 2.5—3mm tall. *Anthers*: anther-wings subquadrate, 1.4—2.0mm long; anther-appendages round, subreniform to ovate-elliptic, 1.0—2.3mm long, 1.5—2.2mm wide, inflexed over the style-apex or erect on the side of the style-stigma-head. *Pollinaria*: Pollinia narrowly kidney-shaped. *Style-apex* truncate, cushion-shaped with an apical depression, level with or projecting above the anthers. *Follicles* erect, solitary, ovoid, 30—96mm long, 12—53mm wide, apex obtusely pointed, surface leathery, smooth or with several thickened

longitudinal lines bearing stout short recurved spines. *Etymology*: *Parapodiopsis* = resembling *Parapodium*.

Discussion: *P. orbiculare* was first placed in the genus *Pachycarpus* by Meyer (1838), but later transferred to *Xysmalobium* by Dietrich (1840). The closely allied *X. confusum* was placed in *Xysmalobium* by Scott-Elliot (1890). However, in 1980, Langley suggested that these two closely related species no longer be placed in *Xysmalobium*, be transferred to the newly proposed but not published genus *Parapodiopsis*. This name was apparently first muted, but not published by Bullock. Langley proposed to use the name because of the vegetative similarity of these two species to the genus *Parapodium*. This is to an extent true, however, vegetatively the two species concerned are also just as close in their overall vegetative facie to *Pachycarpus asperifolius* and allies. In fact, Meisner (1843) pointed out that *P. asperifolius* seems to be intermediate between *Pachycarpus appendiculatus* and *Pachycarpus orbicularis*, and to a small degree this is true. The corona-lobes if looked at too uncritically can seem to be intermediate between *P. asperifolius* and *P. appendiculatum*, however, they are quite distinct and unlike anything previously placed in *Pachycarpus*. The corona-lobes of *P. orbiculare* and *P. confusus* differ from those found in *Pachycarpus* in being dorso-ventrally flattened short scale-like fleshy more or less featureless and erect from the base (without any horizontal basal portion). In fact, these corona-lobes more closely resemble some species previously placed in *Xysmalobium sensu lato*. This may be due to the fact that these species had a common origin with this genus. Some species in *Pachycarpus* have dorso-ventrally flattened corona-lobes that are featureless, in fact, *P. galpinii* has corona-lobes that are almost intermediate between subgenus *Parapodiopsis* and subgenus *Pachycarpus*. Also, the flowers of *P. galpinii* are smaller than subgenus *Pachycarpus* and more like subgenus *Parapodiopsis*. We have decided to treat this taxon as a subgenus under *Pachycarpus*.

To an extent the corona-lobes of this subgenus also resemble those of *Parapodium*, however, unlike this genus they are quite free and not fused to the corolla so

forming a pentagonal truncated cup. Also, the pollinarium of subgenus *Parapodiopsis* is more like that of subgenus *Pachycarpus* than *Parapodium*. In its inflated ovoid thick walled echinate free follicles. *P. confusus* also resembles some species of *Pachycarpus* as well as the tropical genus *Calotropis*. In *P. orbiculare* the narrow thickened ridges that run the follicle length, and which are adorned with recurved spines, at first seem anomalous to *Pachycarpus*, however, this is known from at least one *Pachycarpus* species, viz. *P. vexillaris*. It is also found in *Xysmalobium stockenstroomense* and some *Pachyacris* species. This fruit type is also comparable with *Parapodium*. Hopefully, the above discussion illustrated that subgenus *Pachycarpus*, subgenus *Parapodiopsis*, *Parapodium* and *Woodia* are all clearly related, and that *Parapodiopsis* is to some degree intermediate between the two; although in its overall features it is definitely closer to *Pachycarpus*. There is also a definite connection to *Xysmalobium* as defined in this paper. In *Parapodium* the corona is fused to the corolla (up to the sinuses) making it pentagonally cup-shaped with only the apices free and erect. This is a profound difference and suggests an unusual pollination syndrome. In *Parapodium* the style-apex is conical, fleshy and produced well beyond the anthers and the pollinaria are more delicate and unlike the thickened ones found in both subgenera of *Pachycarpus*. It should also be mentioned that there are also some similarities to the genus *Woodia*, especially to species such as *W. browniana*, but these are distant. However, they do indicate the close relationship of *Pachycarpus*, *Parapodiopsis*, *Parapodium* and *Woodia*, and the possibility exists that all of these may have originated from a common root with *Xysmalobium*.

Distribution: Southern African endemic. South Africa [Northern, Mpumalanga & KwaZulu-Natal provinces] and Swaziland.

Table 4: Comparison of the similarities and differences of *Parapodium*, *Pachycarpus* subgenus *Pachycarpus* and *Pachycarpus* subgenus *Parapodiopsis*.

Character	***Parapodium***	***Parapodiopsis***	***Pachycarpus***
Stem nature	Stout	Stout	Stout
Stem orientation	Erect	Erect	Erect to spreading erect
Leaf blade shape	Broad, linear oblong to lanceolate	Ovate to suborbicular	Linear, oblong to suborbicular
Leaf margin	Flat to slightly undulate	Flat	Flat to undulate
Venation	Prominent below	Prominent below	Prominent to obscure
Inflorescences	Pedunculate	Pedunculate or sessile	Usually pedunculate rarely sessile
Corolla shape & orientation	Globose-campanulate.	Spreading reflexed	Globose-campanulate to reflexed
Minimum & maximum petal length	8—10mm	5.5—13.0mm	7—46mm
Corona-lobe shape	Shortly cup-shape & simple. Not fleshy	Scale-like & simple. Not fleshy.	Ligulate to slipper-like & simple to ornate. Not-fleshy to fleshy
Corona-lobe Orientation	Spreading horizontally then erect at the tip	Erect	Spreading horizontally in the basal part then sometimes erect or inflexed in the apical half
Corona-lobe synorganization	Fused to the corolla up to the sinuses	Free	Free
Style-apex	Conical sometime produced beyond the anthers	Truncated	Truncated

Pollinaria	Delicate, especially the translator-arms	Stout, especially the translator-arms	Stout, especially the translator-arms
Follicles	Fusiform, leathery, with several longitudinal ridges possessing short stout spines	Ovoid, leathery, with several longitudinal ridges possessing short stout spines or smooth	Fusiform, ovoid to globose, leathery, smooth or ridged or winged, rarely with short stout spines.

Key to Species:

1a Peduncles 8 to 32mm long ..... *P. orbicularis*

1b Peduncles subsessile or up to 4mm long ..... *P. confusus*

21. *Pachycarpus orbicularis* E. Mey., Comm. Pl. Afr. Austr.: 212 [1838]. **Type**: *Drège 4980,* South Africa, Eastern Cape province, between St. John's River & Waterfall Bluff, 305m [Holo B†].

Xysmalobium orbiculare (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Type:** As above.

Gomphocarpus orbicularis (E. Mey.) Schltr., in Bot. Jahrb. 20(5), Beibl. 51: 34 [1895]. **Type:** As above.

Asclepias orbicularis (E. Mey.) Schltr., in Journ. Bot. 34: 454 [1896]. **Type:** As above.

Gomphocarpus padifolius Baker, in Saunders, Refug. Bot.: t. 254 [1871]. **Type:** *Wood 1254,* South Africa, KwaZulu-Natal province, Inanda [Holo. K].

Xysmalobium padifolium (Baker) Scott-Elliot, in Journ. Bot. 28: 363 [1890]. **Type:** As above.

Discussion: Plants of this species are robust and often tall, reaching up to 1.3 meters in height. Inflorescences are borne on peduncles between 8 and 32mm long. Corona-lobes are solid, fleshy, more or less ovate in outline with the sides expanded, the outer surface is convex, the inner surface concave and with a small basal bump-like or tooth-like protrusion. Anther-appendages inflexed over the slightly raised truncate style-apex and corpuscula are without membranous appendages. The follicles are ovoid, inflated and with a smooth exocarp which bears several small longitudinal ridges adorned with stout, short dentate spines. The Zulu name is *Itshongwe* (Scott-Elliot, 1909). Plants are found growing among large rocks in grasslands or on forest margins, occasionally on Natal Group Sandstone. (Langley, 1980). *P. orbicularis* flowers from October to May, and occurs at altitudes of between 60 to 610 meters. Illustrated by Langley (1980).

Distribution: Southern African endemic. South Africa [KwaZulu-Natal & Eastern Cape provinces] and Swaziland (fig. 19).

Conservation Status: Low Risk (Near Threatened). Seldom collected now, most collections in herbaria are quite old.

Representative Specimens: South Africa: KwaZulu-Natal: *Strey 6511,* Beacon farm, Umtamvuna [NH, PRE]; *Wood 3924*, near Ungoya [NH]; *Langley 2*, Between Nottingham Road & Balgowan [NU]; *Gerstner 3287*, Indula, Entonjaneni [NH]. Eastern Cape: *Arkell 55*, Mzamba, above Thompson's Lagoon [NH]; *Tyson 2810*, near Fort William [SAM]; *Galpin 5794*, near Kwenzuha river mouth [PRE]; *Pegler 887*, Kentani [K, PRE]; *Phillipson 1160*, Menziesberg [UFH]; *Flanagan 758*, near Komga [PRE]; *Wood 3151*, East London [PRE]; *Galpin 7990*, Hogsback [PRE]; *Strey 10116*, Umsikaba [NH]. Without Precise Locality: *Barber s.n.* [GRA]; *Flanagan 758* [GRA]. **Swaziland:** *Compton 31086*, Mpisi [PRE].

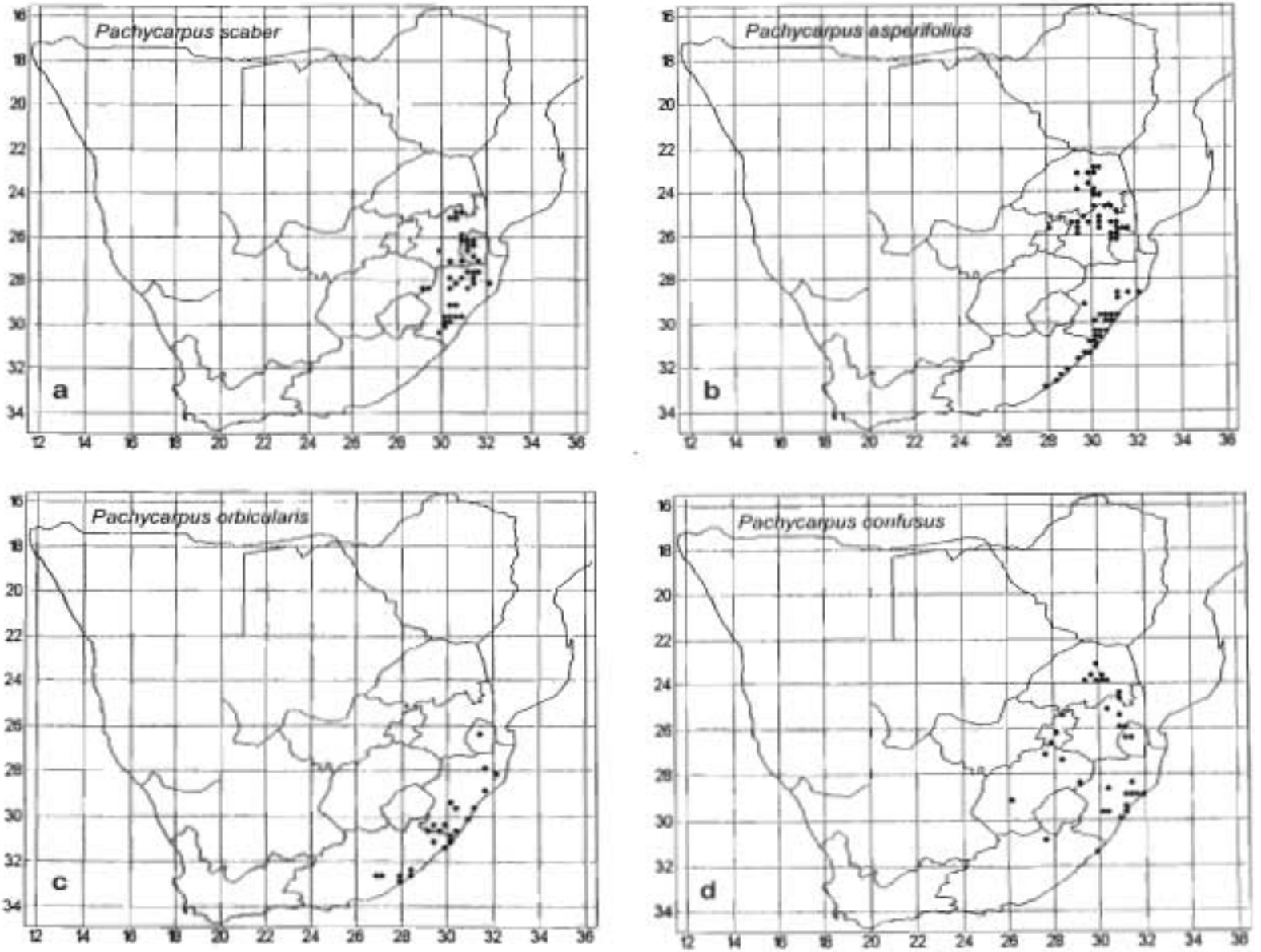

Figure 19. Distribution maps of: a. *Pachycarpus scaber*; b. *P. asperifolius*; c. *P. orbicularis* and; d. *P. confusus*.

22. *Pachycarpus confusus* (Scott-Elliot) Nicholas *Comb. Nov.* **Types**: *Gerrard 1282,* South Africa, KwaZulu-Natal province, Highlands [Lecto. K. Isolecto PRE]. *Wood 1163,* South Africa, KwaZulu-Natal province, Inanda [Iso. *n.v.*]; *Saunders s.n.,* South Africa, KwaZulu-Natal province, without precise locality [Iso. *n.v.*].

Xysmalobium confusum Scott-Elliot, in Journ. Bot. 28: 363 [1890]. **Types:** As above.

Asclepias confusa (Scott-Elliot) Schltr., in Journ. Bot. 34: 454 [1896]. **Types:** As above.

Gomphocarpus rectinervis Schltr., in Bot. Jahrb. 20(5), Beibl. 51: 38 [1895]. **Type:** *Schlechter 4429,* South Africa, Gauteng Province, Houtboschberg [Iso. K].

Asclepias rectinervis (Schltr.) Schltr., in Journ. Bot. 34: 456 [1896]. **Type:** As above.

Discussion: Plants of this species are robust and reach up to 1.2 meters in height. Inflorescences are subsessile, if pedunculate then these very short and never more than 4mm long. Corona-lobes solid, fleshy, more or less obovate, swollen apically, with inner surface smooth and without any projecting process. Style-apex raised above the anthers by 0.5 to 1.25mm. Corpuscula with two narrow membranous wings attached laterally. Follicles are subglobose inflated and with a thick, smooth leathery exocarp, similar to *Calotropis*. Plants are found growing in well-drained grasslands. *P. confusus* flowers from October to February and occurs at altitudes of between 425 to 1435 meters, as low as 60 meters in Mozambique. Illustrated in Wood (1912) and Langley (1980).

Distribution: Southern African endemic. South Africa [Northern, Mpumalanga, KwaZulu-Natal & Eastern Cape (northeastern region bordering Natal) provinces] and Swaziland. Also in Mozambique.

Conservation Status: Low Risk (Near Threatened). Seldom collected now, most collections in herbaria are quite old.

Representative Specimens: South Africa: Northern: *Pole Evans 4728*, Haenertsburg [PRE]; *Breijer 22048*, Minastone, Louis Trichardt [PRE]; *Scheepers 1089*, Westfalia Estate, Duiwelskloof [PRE]; *Wager 23020*, Woodbush [PRE]; *Vahrmeÿer 156*, Letaba district, Paardeplaas [PRE]; *Bolus 10939*, near Houtbosch [PRE]. Mpumalanga: *Thorncroft 684*, Moodies, near Barberton [NH]; *Munro s.n.*, Vaalhoek [PRE 29412 fruit only]; *van der Schijff 4966*, Bedford, Pilgrims Rest district [PRE]; *Strey 3144*, Wemmershoek, near Lydenburg [PRE]; *Jenkins 6708*, Waterval [PRE]. KwaZulu-Natal: *MacDevette 1451*, Cedara State Forest [PRE]; *Haygarth s.n., sub Wood 11008*, Komo Hulliland, Zululand [GRA, NH]; *Stirton 459*, Ngoye Forest Reserve [PRE]; *Acocks 12971*, near Eshowe [PRE]; *Gerrard 1273*, Zululand [BM photo]; *Huntley 114*, near Pinetown, Malvern [PRE fruit only]; *Haygarth 89*, Krantzkloof [NH]. Eastern Cape: *Strey 10116*, Umsikaba, Ndindini. **Swaziland:** *Compton 31086*, Manzini, Mpisi [NBG]. **Mozambique:** *Faulkner 358*, Namagoa, 200kms inland from Quelimane [PRE].

Excluded Southern African Names

Pachycarpus section *Campanulati* (Schltr.) Nicholas & Goyder = ***Trichocodon* (D.M.N. Sm.) Nicholas**

Pachycarpus section *Trichocodon* D.M.N. S. = ***Trichocodon* (D.M.N. Sm.) Nicholas**

Pachycarpus albens E. Mey. = ***Pachyacris albens* (E. Mey.) Nicholas & Goyder**

Pachycarpus campanulatus N.E. Br. var. *campanulatus* = ***Trichocodon campanulatus* (N.E. Br.) Nicholas var. *campanulatus***

Pachycarpus campanulatus N.E. Br. var. *sutherlandii* N.E. Br.= ***Trichocodon campanulatus* (N.E. Br.) Nicholas var. *sutherlandii* (N.E. Br.) Nicholas**

Pachycarpus concolor sensu Meisn. = ***P. asperifolius* Meisn.**

Pachycarpus crispus E. Mey. = ***Pachycarpus crispa* (E. Mey.) Nicholas & Goyder**

Pachycarpus fulvus (N.E. Br.) Bullock = ***Sigridia viridiflora* (E. Mey.) Nicholas**

Pachycarpus gerrardii N.E. Br. = ***Trichocodon campanulatus* (N.E. Br.) Nicholas var. *gerrardii* (N.E. Br.) Nicholas**

Pachycarpus gomphocarpoides E. Mey. = ***Woodia gomphocarpoides* (E. Mey.) Nicholas**

Pachycarpus grandiflorus E. Mey. var. *chrysanthus* N.E. Br. = ***Pachycarpus grandiflorus* E. Mey. subsp. *grandiflorus***

Pachycarpus grandiflorus E. Mey. *var. elatocarinatus* = ***Pachycarpus grandiflorus* E. Mey. var. *grandiflorus***

Pachycarpus humilis E. Mey. = ***Aidomene humilis* (E. Mey.) Nicholas & Goyder**

Pachycarpus inconstans N.E. Br. = ***Pachycarpus asperifolius* Meisn.**

Pachycapus insignis N.E. Br. = ***Pachycarpus concolor* E. Mey. var. *transvaalensis* (Schltr.) Nicholas**

Pachycarpus ligulatus E. Mey. = ***Pachycarpus dealbatus* E. Mey.**

Pachycarpus linearis N.E. Br. = ***Trichocodon linearis* (N.E. Br.) Nicholas**

Pachycarpus marginatus E. Mey. = ***Woodia mucronata* (Thunb.) N.E. Br.**

Pachycarpus reflexus Steud. = ***Pachycarpus reflectens* E. Mey.**

Pachycarpus rigidus E. Mey. var. *tridens* E. Mey. = ***Pachycarpus rigidus* E. Mey.**

Pachycarpus rostratus N.E. Br. = ***Trichocodon rostratus* (N.E. Br.) Nicholas**

Pachycarpus stelliceps N.E. Br. = ***Trichocodon stelliceps* (N.E. Br.) Nicholas**

Pachycarpus transvaalensis (Schltr.) N.E. Br. = ***Pachycarpus concolor* E. Mey. var. *transvaalensis* (Schltr.) Nicholas**

Pachycarpus schweinfurthii (N.E. Br.) Bullock = ***Pachycarpus lineolatus* (Decne.) Bullock**

Pachycarpus validus (Schltr.) N.E. Br. = ***Pachycarpus asperifolius* Meisn.**

Pachycarpus vexillaris E. Mey. var. *stenoglossus* E. Mey. = ***Pachycarpus stenoglossus* (E. Mey.) N.E. Br.**

Pachycarpus vexillaris Steud. = ***Pachycarpus vexillaris* E. Mey.**

Pachycarpus viridiflorus E. Mey.= ***Sigridia viridiflora* (E. Mey.) Nicholas**

PARAPODIUM E. Mey., Comm. Pl. Afr. Austr.: 221 [1838]. **Type species:** ***Parapodium costatum*** E. Mey.

Rhombonema Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 41 [1895]. **Type species:** *Rhombonema luridum* Schltr.

Description: *Habit*: Perennial geophytic herb; with milky latex. *Underground organ* a thickened stem-tuber. *Stems* 1, unbranched or 1 to 3 branched at the base, stout, erect, 75—275mm tall, leaves equally spaced or more often crowded at the base, shortly hairy. *Leaves* opposite, spreading to almost erect, petiolate; lamina oblong-linear to linear-lanceolate, 37—137mm long, 5.5—31.0mm wide, coriaceous, apex usually acute occasionally obtuse, base rounded to cuneate, margins flat & smooth to crispate or undulate, midrib stout, veins of all levels prominent below, usually glabrous, occasionally shortly hairy; petiole 12.5—38.0mm long, channeled above. *Inflorescences* 3—6 per stem, umbel-like, erect, produced laterally at the nodes, 3—9-flowered; peduncles stoutish, 2—25mm long. *Flowers* globose-campanulate or hemispherical; pedicels 6.5—12.5mm long. *Calyx* 5-merous; lobes 6.2—10.0mm long, almost as long as the petals. *Corolla* 5-merous, divided to about halfway; tube subglobose to globose-campanulate, 2.0—3.5mm deep; lobes spreading but recurved at the tips, oblong-lanceolate to ovate-lanceolate, 4.5—9.0mm long, 3.4—3.6mm wide, apex subacute, reflexed & spreading, glabrous, dull purple-brown, violet, creamy brown or dark purple-brown. *Staminal-corona* in 2-series. *Outer-corona* arising very close to the gynostegial-column base, consisting of 5 lobes, which are pressed close to the corolla-tube or fused for half of their length to each other & to the very base of the corolla-tube, free above but pressed close to the corolla, fleshy, erect, dorso-ventrally compressed, transversely oblong to obcordate in shape, 1—3mm long, 2.6—4.5mm wide, upper margin truncated & incurved, outer keel stout, lobes contiguous laterally forming a short pentagonal-cup, projecting beyond the

mouth of the corolla tube, white. *Inner-corona* almost obsolete, consisting of 5 narrow lobules alternating with the outer corona-lobes, channeled down the middle & adnate to the corolla-tube. *Staminal-column*: Anther-wings triangular or hatchet-shaped; anther–appendages white, membranous, ovate to oblong, ±2.2mm long, apex acute, erect, applied to the style-apex. *Pollinaria*: Pollinia solitary & pendulous in each anther-sac, attached in pairs by long translator-arms to a long narrow corpusculum. *Style-apex* stout, conical to columnar, truncate or shortly bifid at the tip, not or only just exceeding the anthers. *Follicles* solitary, erect, lanceolate-fusiform, ±125mm long, ±25mm wide, leathery, surface smooth or with longitudinal wings that are irregularly toothed, teeth 3—6mm long. *Etymology*: From the Greek *para-* (= near or similar), *podion* (= foot), the meaning is not clear, but may refer, in some way, to the corona-lobes.

Discussion: *Parapodium* is quite distinct from all other genera in the Asclepiadinae. It is distinguished by the possession of the following set of correlated characters: Stems usually solitary and stout; corolla-tube globose-campanulate; staminal-corona noticeably in two series, outer-corona arising very close to the gynostegial-column base, with 5 lobes fused for half of their length to each other and to the base of the corolla-tube, dorso-ventrally compressed, contiguous laterally forming a short pentagonal-cup, projecting beyond the mouth of the corolla tube, inner-corona almost obsolete, lobule-like; style-apex stout, not or just exceeding the anthers; and follicles solitary, leathery, with longitudinal wings that are irregularly toothed. In essence, because the staminal-corona is so closely associated with or even partially fused to the corolla it functions as a corolline-corona. This is highly unusual within the Asclepiadinae. As pointed out by N.E Brown (1907), Schlechter misunderstood this genus erecting *Rhombonema* for *P. costatum*. This now forms part of the synonymy for this taxon. *Parapodium* bears a close relationship to the genera *Pachycarpus* (especially subgenus *Parapodiopsis*) and, to a lesser extent, *Woodia*. The connection with *Pachycarpus* was even noticed by Mogg, who on one of his specimens (*Mogg 16773* in PRE) has written: "nearest *P. galpinii*". A case could

probably be made to treat it as a subgenus of *Pachycarpus*, however, it differs in its corona structure (which, as already pointed out, is highly unusual), less robust gynostegial-column and quite different (more delicate and smaller) pollinaria. Although in these latter features it is somewhat similar to *Pachycarpus* subgenus *Parapodiopsis*. *Parapodium* is reduced here from three to two species; the reasons for this are discussed below. It is not a commonly encountered genus.

Distribution: Southern African endemic. Botswana, Lesotho and South Africa [Northern, North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal & Eastern Cape provinces]

Key To Species:

1a Leaves oblong to oblong-linear, leaf margin flat & not undulate or crispate ..... *P. costatum*

1b Leaves linear-lanceolate to lanceolate, leaf margin very undulate or crispate ..... *P. crispum*

1. ***Parapodium costatum*** E. Mey., Comm. Pl. Afr. Austr.: 222 [1838]. Type: *Drége s.n.*, South Africa, Eastern Cape province, Aliwal North area, Witteberg Range [Holo. B†].

Metastelma costatum (E. Mey.) Dietr., Syn. Pl. 2: 908 [1840]. **Type:** As above.

Rhombonema luridum Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 41 [1895]. **Type**: *Schlechter 3610,* South Africa, Gauteng province, Magaliesberg, 3.10.1893, 5000ft (= 1524m) [Holo. B† Iso. GRA, MEL *fide* Forster (1994), NH & PRE two specimens].

Discussion: The leaves of this plant are quite unusual in their orientation. The petioles curve out in a 90° arch so that the leaf blade is held erect and parallal to the stem. The petals are concavely chaneled on the inner surface, the top of this channel is level with the style-apex, togther they probably help in guiding the pollinating insects leg to the corona

basin, here it is placed in position below the anther-wings ready for pollinarium extraction. The style-apex may be entire or shortly bifid. N.E. Brown (1907) separated *P. costatum* from *P. simile*, on the fact that the latter has a style-apex that does not elongate past the anther-appendages and differently shaped anther-wings. However, we have found both these characters to be only marginally diagnostic. Sometimes the size and length of the style-apex can vary greatly in the same specimen. We have thus opted to treat *P. simile* as a variety under *P. costatum*. Some specimens can be found in which the style-apex only minutely exceeds the anther-appedages, we have placed these in var. *simile* although others may consider them to be var. *costatum*. We have opted to treat only those specimens in which the style-apex greatly exceeds the anther-appendages as in the type variety. The shape of the anther-wing in var. *costatum* varies so greatly that the anther-wing shape in var. *simile* does not prove to be diagnostic at the specific level. N.E. Brown (1907) who had only seen the follicles of *P. simile* suggests that the follicles of *P. costatum* may prove to be different. However, we have seen a specimen of *P. costatum* with fruit and it is the same as that of *P. simile*, viz. large (112—128mm long, 25—30mm wide) and ovoid, with several longitudinal wings irregularly adorned with erect teeth. We have opted to use varietal status instead of subspecific status because these two taxa are sympatric. The leaves are apparently cooked as a type of spinach or pot herb, such types of dishes are locally called *imifino* (Fox & Norwood Young 1982 & Peters *et al.*, 1992).

1a. Style-apex not exerted beyond the anther-appendages ..... var. *simile*

1b. Style-apex not exerted beyond the anther-appendages ..... var. *costatum*

1a. *Parapodium costatum* E. Mey. variety ***costatum***

Discussion: In this variety the style-apex is produced well beyond the anthers. Plants are usually found growing in grasslands on grey sandy or red loamy soils, usually in or above vleis or in open grassy woodlands (e.g. *Faurea* woodlands with sour grasses). Flowering occurs between October and January (peaking November to December) rarely as late as March, and flowers are said to be brown or liver coloured. Plants are reported as rare or occasional and can be found at altitudes of between 1050 and 1550 meters. Illustrated by Anonymous (1931)

Distribution: Southern African endemic. Botswana, Lesotho and South Africa [Northern, North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal & Eastern Cape province] (fig. 20).

Conservation status: Seldom collected. Probably threatened to vulnerable in many areas. This taxon will certainly be at risk sometime in the next century.

Representative Specimens: Botswana: *Tapscott 2467*, Lobastsi [PRE]. **Lesotho:** *Dieterlen 189*, Leribe [PRE]. **South Africa:** Northern: *Leendertzz 6378*, Warmbaths [PRE]; *Codd 2266*, near Nylstroom [PRE]; *Thode A1731*, Warmbaths [PRE]; *Story 1544*, 39Kms NE of Nylstroom [PRE]. North West: *Hanekom 2008*, Wolwerand, Klerksdorp [PRE]; *van der Westhuizen 882*, Dassiesrand [PRE]; *Kinges 1999*, Haakboslaagte [PRE] Gauteng: *Smith 1118*, between Lyttelton & Irene [PRE]; *Mogg 10102*, Pretoria [PRE]; *Pole Evans H13216*, Lyttelton Junction [PRE]; *Strey 3945*, Pretoria [PRE]; *Leendertzz 9500*, Heidelberg [PRE]; *Comins 898*, Pretoria [PRE]; *Smuts 1154*, Johannesburg [PRE]; *Smith 2133*, Middelkop farm, Pienaars River [PRE]; *Codd 7591*, near Bronkhorstspruit [PRE]; *Mogg 16773*, Mountain View, Magaliesberg [PRE]; *Burtt Davy 9118*, Uitgevallen, Heidelburg [PRE]. Mpumalanga: *Thode A2835*, Zondagsfontein [PRE]; *Codd 3153*, near Middelburg [PRE]. Free State: *Jacobsz 2094*, wild in Drakensberg Botanic Gardens [PRE]; *Acocks 13894*, near Frankfurt [PRE]; *Pont 617*, Kroonstad [BLFU, PRE flowers & fruits]; *Acocks 20992*, Greenlands Station, Heibron District

[PRE]; *Gemmell s.n.*, Eagles Nest, Bloemfontein [BLFU 8451]; *Potts 3929*, Vereeniging [GRA]; *Jacobsz 179*, Rensburgskop, Swinburne [PRE]. KwaZulu-Natal: *Wahl 15363*, Utrecht [PRE] Eastern Cape: *Hilner 18*, Barkley East [GRA].

2b. *Parapodium costatum* E. Mey. variety ***simile*** (N.E. Br.) Nicholas. *Stat. Nov.*

Parapodium simile N.E. Br., in Fl. Cap. 4(1): 559 [1907]. **Types:** *Pegler 1022*, South Africa, Gauteng province, near Rustenberg, alt. 1219m [Isosyn. PRE flowers badly eaten]. *Bolus 6348*, South Africa, Free State province, near Besters Vlei [Isosyn. *n.v.*].

Discussion: This variety is distinguished by its smooth, flat leaf margin and style-apex not exceeding the anthers and its differently shaped anther-wings. In this variety the flowers are also on average smaller than in the type variety and petals slightly differently shaped. The flowers are said to be dull brownish-green. Otherwise as in var. *costatum*. With its small style-apex not exceeding the anther-appendages this variety is closer to *Pachycarpus* subgenus *Parapodiopsis* and may form some ancient link with the ancestors of this genus.

Distribution: South African endemic [Gauteng, Free State & KwaZulu-Natal provinces] (fig. 20).

Conservation status: Vulnerable. Not a commonly encountered or collected species.

Representative Specimens: South Africa: North West: *Leendertz 9505*, Rustenburg [PRE]. Gauteng: *Louw 970*, Onderstepoort [PRE]; *Pole Evans s.n.*, near Hebron [PRE 50980 with immature fruit]. KwaZulu-Natal: *Greene 367*, Estcourt district [NH].

2. *Parapodium crispum* N.E. Br., in Hook. Ic. Pl. 8(2): t.2744 [1902]. **Type:** *Drége s.n.*, South Africa, Eastern Cape province, on grassy hills near Shiloh, 1219m [*n.v.*]. *MacOwan 1343*, Somerset division, Boschberg [Isosyn. GRA, PRE]; *Bolus s.n.*, on the Sneeuwberg, near Graff Reinet at 4100ft (= 1250m) [*n.v.*]

Pachycarpus gomphocarpoides E. Mey., Comm. Pl. Afr. Austr.: 213 [1838], *pro parte*. **Type:** *Drège s.n. (I, a.),* South Africa, Eastern Cape province, in hilly grasslands near Schiloh, alt. 4000ft (= 1219m.) [*n.v.*].

Discussion: As pointed out by N.E. Brown (1907) this species bears remarkable similarity to *Woodia gomphocarpoides* and *Woodia mucronata*, however, dissection of the flowers immediately shows the distinctness of this species and places it firmly within the genus *Parapodium*. This species is distinguished within the genus by its leaves which have undulate margins and style-apex which does not exceed the anthers. *P. crispum* is found growing on grassy hillsides. Plants flower between October and March and occur at altitudes of between 500 and 1800 meters.

Distribution: South African endemic. South Africa [Eastern Cape province only] (fig. 20).

Conservation status: Vulnerable, approaching endangered. The Eastern Cape has a very high population and the few natural areas left are heavily exploited. As a result, this is not a commonly encountered plant.

Representative Specimens: South Africa: Eastern Cape: *AWE & RDA Bayliss 8425 & 8474*, near Kommadagga [GRA]; *Acocks 23449*, Goliadskraal, Graaff Reinet district [PRE with good underground parts]; *Cooper 531*, without precise locality [PRE]; *Giffen s.n.*, Victoria East, Fort Beaufort [PRE]; *Acocks 23264*, Middelburg [PRE].

WOODIA Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 30 [1894]. **Type species:** *Woodia verrucosa* Schltr.

Description: *Habit:* Perennial geophytic, often xerophytic herb; with milky latex. *Underground organ:* A fleshy, cylindrical, deep-seated or sometimes napiform-like stem-tuber. *Stems* 1 to several, unbranched or branched at the very base, erect, sometimes slightly almost fleshy, cylindrical or flattened & shallowly grooved down the flattened

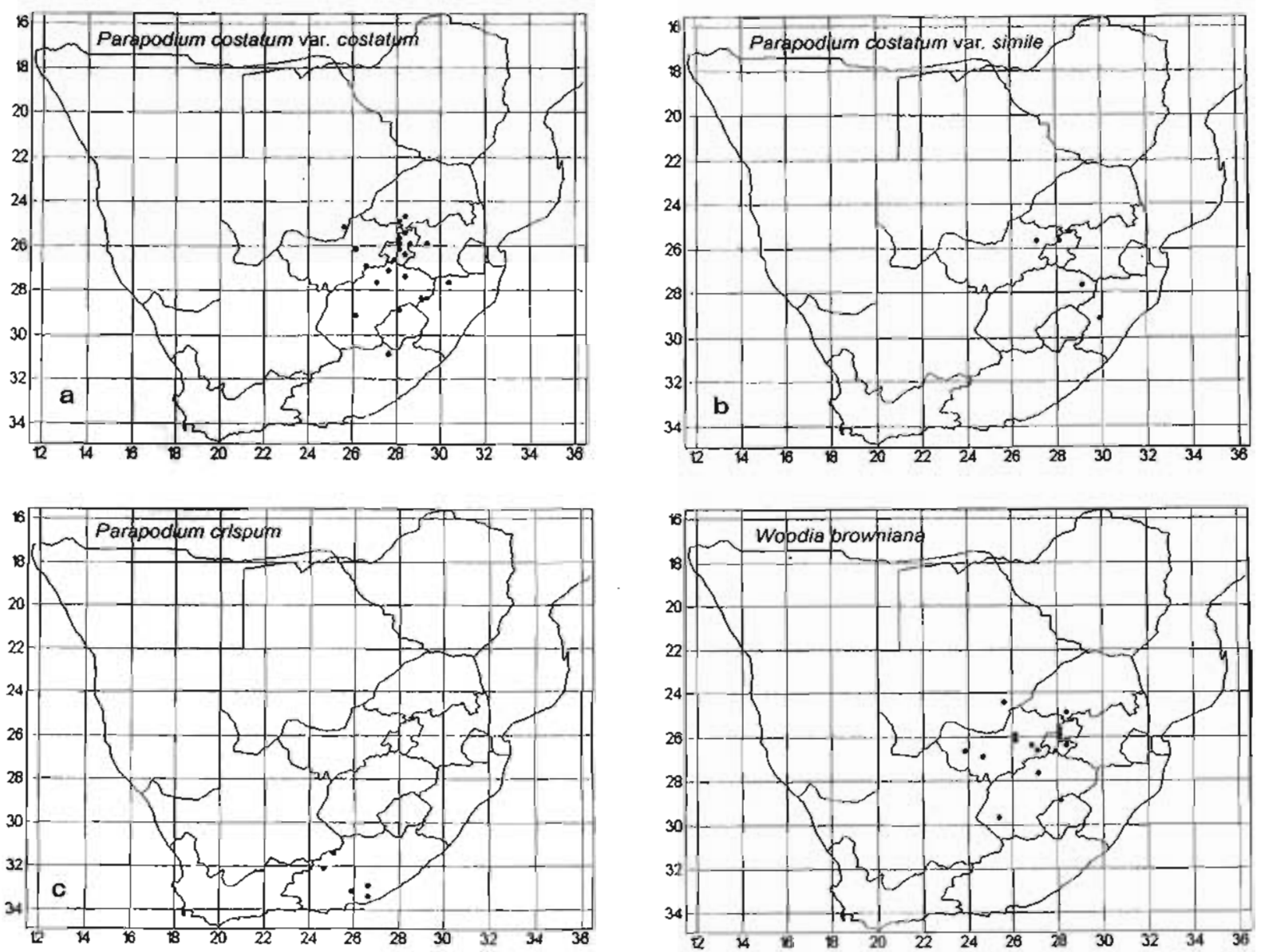

Figure 20. Distribution maps of: a. *Parapodium costatum* var. *costatum*; b. *P. costatum* var. *simile*; c. *P. crispum* and; d. *Woodia browniana*.

surfaces, 100—500mm tall, 2—14mm thick, glabrous or uni- to bifariously pubescent. *Leaves* 4—16 pairs per stem, opposite, simple, spreading erect to erect, subsessile or petiolate; blade usually linear, linear-lanceolate, lanceolate, ovate-oblong to elliptic, sometimes all types on the same plant, 24—180mm long, 1—36mm wide, membranous to coriaceous, apex acute, acuminate to obtuse, sometimes mucronate, with a pungent apiculus or twisted spirally, base cuneate, subcordate to rounded, margins usually crispate or undulate, sometimes flat, adaxial & abaxial surfaces glabrous or glabrate, margin scabrid, sometimes slightly thickened, midrib prominent, sometimes secondary veins prominent; petiole sometimes subsessile, 2—70mm long, sometimes more or less flattened. *Inflorescences* 2—13 per stem, erect, umbel-like, hemispherical to subglobose, solitary & terminal or with some produced lateral at the upper nodes, 3—32-flowered; peduncles sessile, subsessile or up to 38mm long (varying widely on same plant), unifariously puberulous; bracts ovate-lanceolate, subulate, linear-subulate to linear-filiform, 2—5mm long, ±0.5mm wide. *Flowers* Cupulate to reflexed; pedicels 5—22mm long, glabrous, puberulous to pubescent. *Calyx* 5-merous, shorter or longer than the corolla, green; lobes linear, lanceolate, oblong-lanceolate to narrowly ovate, 2—9mm long, 0.75—4.0mm wide, apex acute to pointed, adaxial surface glabrous, abaxial surface glabrous to sparsely pubescent; usually with septal glands, ±0.15mm long, ±0.07mm wide. *Corolla* 5-merous, divided almost to base, recurved erect, spreading to reflexed, greenish yellow, greenish purple, reddish brown, brown & green or creamy green; lobes ovate, elliptic, oblong, oblong-ovate to lanceolate, 3—12mm long, 1.5—5.6mm wide, apex oblong-acute, subacute to obtuse, puberulous to sparsely pubescent. *Staminal-corona* arising from the gynostegial-column base, 5-merous; lobes free to the base, erect, dorso-ventrally flattened, fleshy, free from the corolla & gynostegial column except at very base, linear-blong, subrhomboid, suborbicular, transversely oblong or subquadrate, 1—5.5mm long, 1.5—3.4mm wide, entire or trifid & deeply 3-lobed, if entire then apex truncate to obtuse, sometimes with a small dentate tooth in the middle, rarely this 1.7mm

long, stout, fleshy & linear-oblong or centrally notch & slightly recurved, sometimes slightly swollen, reaching to the middle of the gynostegial-column or level with the style-apex, inner-surface convex to flattened, sometimes with a small keel, outer-surface convex or flattened, laterally basal margins simple or with large to small auricles, 0.5—0.9mm long, ±0.7mm wide, sometimes broadly clavate & small basal tooth, cream, mauve brown, browny-yellow to orange (subgenus *Pseudowoodia*), if 3-lobed then middle lobe stout, tips incurved & reaching to the level of the style-apex, inner-surface concave & strongly keeled down the middle lobe, middle-lobe lanceolate, 2.2—3.4mm long, lateral sublobes linear or linear-oblong, shorter than middle lobe, 1.6—2.2mm long, and white (subgenus *Woodia*). *Staminal-column* 1.5—4.5mm tall, slightly to much & abruptly constricted at or below the middle & the apical portion obconical. *Stamens:* anther-wings prominent triangular, quadrate to subquadrate, sometimes with a terminal notch; anther-appendages ovate, suborbicular or reniform, apex acute, obtuse or emarginate, inflexed over the rim of the style-apex if flat. *Style-apex* truncate, centrally depressed & 5-angled, sometimes small, not exceeding the anthers or rarely conical & exceeding the anthers, sometimes with papillate glands just above the corpuscula. *Pollinaria* Pollinia solitary in each anther-sac, pendulous, subquadrate, rectangular, suborbicular, obovate or boomerang-shaped, translator-arms curved, straight or ligulate, sometimes broad & flat with hyaline margins, attached terminally to the pollinia; corpusculum narrowly ovate. *Follicles* solitary, erect, stoutly fusiform, obliquely ovoid to ellipsoid, 40—120mm long, 15—25mm wide, sometimes almost inflated, apex obtuse to acute, surface echinate with filiform projections, or with short recurved subulate spines (1.0—3.4mm long) in longitudinal lines. *Seeds* ovate, bifacial, dorso-ventrally flattened, shallowly convex above, shallowly concave below, rugulose-tuberculate, dark brown. *Etymology*: *Woodia*, Named after John Medley Wood (1827—1915) early South African botanist and plant collector. Eventually curating the Natal Herbarium from 1882 to 1915. Often referred to as the Father of Natal botany.

Discussion: We have expanded the concept of *Woodia*, traditionally with only three species, to include five species previously in *Xysmalobium*. Langley (1980), after his revision of *Xysmalobium*, proposed using *Pseudowoodia* for these five species which he felt were similar to, but separate from *Woodia*. There would seem to be a good case for keeping *Pseudowoodia* and *Woodia* distinct at the generic level if the extremes of these two taxa are examined. In fact, some of the species concerned seem totally different and not even closely related. This can be easily seen if *W. mucronata* (subgenus *Woodia*) and *W. pearsonii* (subgenus *Pseudowoodia*) are laid side by side. However, the two subgenera are clearly linked by *W. singulare* and *W. browniana* which are more or less intermediate in both vegetative facie and corona structure.

In subgenus *Woodia* the leaves are ovate to lanceolate, flat to very undulate, with margins never revolute, petals are spreading erect with margins revolute, corona-lobes are trident-shaped distinctly and deeply divided into 3 teeth-like lobes. In subgenus *Pseudowoodia* the the leaves vary from ovate-lanceolate to linear, flat to very undulate, with margins not to only slightly revolute, petals are spreading erect to reflexed, corona-lobes are subquadrate more or less entire (never deeply divided but often with small lateral auricles). We have placed *W. browniana* first in our series as, despite its wide range of variation, it is the species most closely allied to *Xysmalobium*, especially *X. stockenstroomense*. All other members of this genus can be derived from the characteristics exhibited by this species. Closely allied to *W. browniana* is *W. singulare*; which comes next in our series. In this species the lateral shoulders of the corona-lobe have become slightly indented before joining with the central portion of the lobe. This structure is the precursor of the corona-lobes found in subgenus *Woodia* (*W. verruculosa* and *W. mucronata*) where the corona-lobe becomes deeply sublobed. It was because of this that *W. singulare* was included with these species by N.E. Brown (1907). However, although somewhat intermediate between subgenus *Woodia* and subgenus *Pseudowoodia*, we believe *W. singulare* to be closer to *W. browniana* than to *W. mucronata* and have

thus placed it in subgenus *Pseudowoodia*. Plants of this genus are found growing in open short, often stony or regularly burned, grasslands or in arid sandy, stoney and sparsely vegetated areas especially of the Karoo.

Distribution: Southern African endemic. Botswana, Lesotho, South Africa [all provinces] and Swaziland.

Key To Subgenera:

1a Corona-lobes distinctly 3-toothed or lobed ..... subgenus *Woodia*

1b Corona-lobes more or less entire, never distinctly 3-toothed or lobed ..... subgenus *Pseudowoodia*

WOODIA Schltr. **Subgenus *PSEUDOWOODIA*** Bullock ex Nicholas. *Subgen. Nov.* ***Habitus*** *perennis, geophyticus, ad aliquando xerophyticus cum latice.* ***Organum-subterraneus*** *tubera caulie carne cylindrus insidens-profundus vel napiformis.* ***Caulis*** *solitarius ad aliquot, erectus, 100—500mm elatus.* ***Folio*** *lamina linearis ad ellipticis, 24—180mm longo, 3—36mm latus, margine crispatus vel undulatus, aliquando planus, principalis costa prominens.* ***Inflorescentia*** *hemisphaeris, umbelliformis, solitarius, et terminalis vel in lateralis supernus nodis producens; pedunculis 0—21mm longo.* ***Corolla*** *ad basis divisus, erectus ad reflexus; lobus ovatis ad lanceolatis, 3—9.5mm longus, 1.5—4.5mm latus, apice habens parvo oblique incisura, margine revolutus.* ***Staminalis coronae*** *ad gynostegio-columna basim exorientia, lobi discretus, erectus, complanatus dorso-ventralis, linearis-oblongis ad suborbicularis, squamiformis, 1—5.5mm longus, 1.5—2.8mm latus, apice obtusus, cum parvo dente vel hic crassus ad 1.7mm longo vel emarginatus, plerumque cum grandis vel parvis lateralis-basis auriculatus.* ***Staminis-***

columna *ad vel infra medium constrictus, apicalis obconicus.* ***Folliculi*** *solitarius, erectus, fusiformis ad ellipsoideus, partialis inflatus, 40—78mm longus, 15—25mm latus, pagina echinatus vel cum parvus recurvatus spina.* **TYPUS:** *Woodia gomphocarpoides* (E. Mey.) Nicholas, *vide infra.*

Pseudowoodia Bullock ex Stewart & Langley, M.Sc. thesis: 77 [1980]. Not effectively published.

Description: *Habit:* Perennial geophytic, often xerophytic, herb. *Underground organ:* A fleshy, cylindrical, deep-seated or sometimes napiform stem-tuber. *Stems* 1 to several, unbranched or branched at the very base, erect or spreading erect, really almost trailing, sometimes almost fleshy, cylindrical or flattened & shallowly grooved down the flattened surfaces, 100—500mm tall, 2—14mm thick, glabrous or bifariously pubescent. *Leaves* 4—16 pairs per stem; lamina usually linear, linear-lanceolate to lanceolate, occasionally ovate to elliptic, sometimes all types on the same plant, 24—180mm long, 3—36mm wide, membranous to coriaceous, apex acute to sharply pointed, rarely obtuse, sometimes mucronate or twisted spirally, margins usually crispate or undulate, sometimes flat; petiole sometimes subsessile or up to 70mm long, sometimes more or less complanatus. *Inflorescences* 3—13 per stem, hemispherical to subglobose, solitary & terminal or with some produced lateral at the upper nodes, 3—12-flowered; peduncles sessile, subsessile or up to 21mm long (varying widely on same plant), unifariously puberulous; bracts ovate-lanceolate, subulate, linear-subulate to linear-filiform, 2—5mm long, 0.55mm wide. *Flowers* Cupulate to reflexed; pedicels 5—18mm long, pubescent to puberulous. *Calyx:* Lobes lanceolate, oblong-lanceolate to narrowly-ovate, 2.0—7.3mm long, 0.75—4.0mm wide, adaxial surface glabrous, abaxial surface glabrous to sparsely pubescent; septal glands 0.15mm long, 0.07mm wide. *Corolla:* Spreading erect, spreading to reflexed, greenish-yellow, greenish purple, reddish-brown, brown & green; lobes ovate, elliptic, oblong-ovate to lanceolate, 3.0—9.5mm long, 1.5—4.5mm wide, apex oblong-acute, subacute to obtuse & with a small oblique notch, margins revolute. *Staminal-*

corona arising from the gynostegial-column base, 5-merous; lobes free to the base, erect, dorso-ventrally flattened, usually smaller at the base expanding to a broader apex, linear-oblong, subrhomboid to suborbicular, 1.0—5.5mm long, 1.5—2.8mm wide, apex truncate to obtuse, sometimes with a small dentate tooth in the middle, rarely this 1.7mm long, stout, fleshy & linear-oblong or with a central notch & slightly recurved, sometimes slightly swollen, reaching to the middle of the gynostegial-column or level with the style-apex, inner-surface convex to flattened, sometimes with a small keel, outer-surface convex or flattened, lateral basal margins usually with large or small auricles, 0.5—0.9mm long, 0.7mm wide, sometimes broadly clavate & with a small basal tooth; cream, mauve-brown, browny yellow to orange. *Staminal-column* 1.5—4.0mm tall, slightly to much & abruptly constricted at or below the middle, apical portion obconical. *Stamens:* Anther-wings quadrate to subquadrate, 0.4—2.75mm long, 1.1—2.5mm wide, sometimes with a terminal notch; anther-appendages ovate, suborbicular or subreniform, 0.35—1.4mm long, 1—2mm wide. *Pollinaria:* Pollinia suborbicular, obovate or boomerang-shaped; translator-arms curved, straight or ligulate, attached terminally to the pollinia; corpusculum narrowly ovate. *Follicles* solitary, erect, fusiform, obliquely ovoid to ellipsoid, sometimes almost subinflated 40—78mm long, 15—25mm wide, apex obtuse to pointed, surface echinate with filiform projections or short recurved spines produced in longitudinal lines. *Seeds* ovate, bifacial, shallowly convex above, shallowly concave below, rugulose-tuberculate, dark brown. *Etymology: Pseudowoodia* in reference to its resemblance to *Woodia*.

Discussion: This subgenus is similar to subgenus *Woodia* in its vegetative facie except that the leaves tend to be more linear and the corona-lobes not divided. This similarity was reported by both Schlechter (1896) and Brown (1907) who noticed the similarity between *Xysmalobium gomphocarpoides* and *Woodia mucronata*. Bullock too noticed the similarity, coining the name *Pseudowoodia* for these *Woodia* look alikes; however, he never published the name. In his M.Sc. thesis on *Xysmalobium*, Langley (1980) took up

its use and proposed a new genus based on the name. Many specimens seen by him and Stewart now bear *determinavit* labels using combinations in *Pseudowoodia*, however, these have not been validly published. Unfortunately, we have not been able to uphold *Pseudowoodia* as distinct at the generic level. *Woodia*, with its deeply divided 3-lobed corona, appears to differ from *Pseudowoodia*, which has simple undivided corona-lobes. However, the two types are linked by taxa such as *Woodia singulare*, in which the corona, although not deeply tripartate, does appear to be made of 3 segments or sublobes (two shorter lateral segments with a longer middle segment) and *Xysmalobium gomphocarpoides*, in which the two lateral segments or teeth have been reduced to small auricles and the middle segment has become expanded apically and blunt on the upper margin. Because of these bridging taxa the division into two distinct genera would not be appropriate, as a result, we have chosen to place *Pseudowoodia* into an expanded *Woodia* but to express the differences between the two at the subgeneric level.

Distribution: Southern African endemic. Botswana, South Africa [Northern, North West, Gauteng, Free State, Eastern Cape, Western Cape & Northern Cape provinces] and Swaziland.

Key to Species:

1a Corona-lobes with 2 long lateral wing-like margins flanking a long middle section, these not small & auricle-like ..... *W. singulare.*

1b Corona-lobes without 2 long lateral wing-like margins flanking a long middle section, but with 2 small basal auricles .....2.

2a Corona-lobes about as long as broad, suborbicular in shape, much shorter than the gynostegial-column 3

2b. Corona-lobes longer than broad, variously shaped but never suborbicular,

as tall as or slightly shorter than the gynostegial-column ..... 5.

3a Upper margin of corona-lobe emarginate (distinctly cleft) ..... *W. pearsonii*

3b Upper margin of corona-lobe entire 4

4a Corona-lobes 1.5 to 2.0mm tall, ±2mm wide, without lateral lobules or auricles; Eastern Cape province only ..... *W. winterbergensis*

4b Corona-lobes ±1mm tall, ±1.5mm wide, with lateral lobules or auricles; Western Cape province only ..... *W. parviloba*

5a Stems usually slightly climbing & not erect; corona-lobes narrowly stalked below, ovate above ..... *W. fluviale*

5b Stems erect; corona-lobes narrower but not stalked below, linear-oblong to obovate above 6

6a Corona-lobes with lateral lobules or auricles ..... *W. gomphocarpoides*

6b Corona-lobes without lateral lobules or auricles ..... *W. browniana*

1. *Woodia browniana* (S. Moore) Nicholas. *Comb. Nov.* **Type:** *Rand 1053,* South Africa, Gauteng Province, open veld south of Johannesburg [Iso. K].

Xysmalobium brownianum S. Moore, in Journ. Bot. 41: 309 [1903]. **Type:** As above.

Asclepias anisophylla Conrath & Schltr., in Bot. Jahrb. 38: 31 [1905]. **Type:** *Conrath 984,* South Africa, Gauteng Province, Irene [Iso. K].

Discussion: Like *Pachycaris meliodora*, this is one of the few species in the Asclepiadinae to show an amazing range of vegetative variation, however, unlike *P.*

meliodora, which is fairly consistent florally especially in its corona-lobe structure, *W. browniana* has quite diverse corona-lobe structure, so much so that a case could be made to divide it into several infra specific taxa. In this species the corona-lobes are broadly obovate (e.g. *Dieterlen 903*) to wedge-shaped (*Schlieben 9957*) or rarely ovate (*Henrici 189*), usually with protruding rounded (*Moss 10633*) to truncated (*Louw 1207*) shoulders or these rarely almost absent with margins roundly sloping (*Henrici 189*), and with the the middle portion broadly dentate (*Moss 10633*) to sharpley dentate (*Kinges s.n.* PRE 51750) or pungent (*Dieterlen 903*), usually much taller than the side shoulders (*Louw 1207*) or equal with them (*Schlieben 9957*). Plants are rarely encountered and often solitary, and are found growing in open grasslands in a wide range of soil from sand to clay. *W. browniana* flowers October to January or sometimes as late as May. and occurs at altitudes of between 180 and 1550 meters.

Distribution: Southern African endemic. Botswana, Lesotho and South Africa [Northern, North West, Gauteng & Free State provinces] (fig. 20).

Conservation Status: Low Risk (Least Concern). Threatened in some areas especially Gauteng province. Species, such as this one, which occur in arid areas are soon elliminated by human activity, especially the extensive farming or grazing of this marginal land.

Representative Specimens: Botswana: *Codd 8934*, near Molepolole [PRE]. **Lesotho:** *Dieterlen 903*, Ingolosi slope, Leribe [PRE 2 specimens both with good stem-tubers]. **South Africa:** Northern: *Thode A1731*, Warmbaths [NH]. North West: *Sutton 362*, Grasfontein, Lichtenberg [PRE]; *Henrici 189*, Vryburg [PRE]; *Sutton 674*, Goedgedacht [PRE]; *Louw 1207*, near Potchefstroom [PRE]. Gauteng: *Pole Evans 4721*, Irene [PRE flowers & fruit]; *Moss 10633*, Milner Park [J, PRE]; *Pott 390*, Vereeniging [GRA]; *Leendertzz 10849*, Vereeniging [PRE]; *Schlieben 9957*, between Littleton & Pretoria [PRE]. Free State: *Acocks 20996*, near Serfontein Station [PRE]; *Pont 243*, near Kroonstad [PRE]

2. *Woodia singulare* N.E. Br., in Fl. Cap. 4(1): 563 [1907]. **Types**: *Burtt Davy 2933.* Swaziland, ridge between Bremersdorp and Mac Nab's Store [*n.v.*].

Discussion: In this species the leaf margins are flat to undulate, inflorescences are sessile, sepals are shorter than the petals and corona-lobes have side shoulders that are separated from the main or middle part of the lobe by a shallow cleft.; i.e. almost but not quite tripartite. Plants flower from November to December and are found at altitudes of about 800 meters.

Distribution: Southern African endemic. South Africa (Northern & Mpumalanga province) and Swaziland (fig. 21).

Conservation Status: Endangered. Of very limited distribution and very seldom collected.

Representative Specimens: South Africa: Mpumalanga: *Thorncroft 4998*, Barberton [PRE]; *Long s.n.*, Punda Maria [PRE 32243]. **Swaziland:** See type cited above.

3. *Woodia winterbergensis* (N.E. Br.) Nicholas. *Comb. Nov.* **Type:** *Mrs Barber 86,* South Africa, Eastern Cape province, Fort Beaufort Division, valley of the Winterberg Range [Holo. K; Iso. PRE].

Xysmalobium winterbergense N.E. Br., in Fl. Cap. 4(1): 568 [1907]. **Type:** As above.

Discussion: Similar to *W. browniana*, but differing in its corona structure, in which the lobes are ovate with a short dentate projection on the rounded upper margin, and anther-wings, which are large in relation to the other flower parts. Also the corona does not obscure the gynostegial-column to the same degree as in *W. browniana*. Mrs Barber who collected the type specimen in the late 19th century states she only saw one specimen.

Interestingly the plant was flowering in autumn and, unusual for the genus, the flowers are dark-brown green in color. Illustrated in Langley (1980).

Distribution: South African endemic [Eastern Cape Province only] (fig. 21).

Conservation Status: Extinct. This species is only known from one collection made in the Winterberg mountains over 100 years ago.

4. *Woodia gomphocarpoides* (E. Mey.) Nicholas. *Comb. Nov.* **Type**: *Drège s.n. (I, d),* South Africa, Eastern Cape province, Nieuw Veld, between Brakriver and Uitvlugt, 3000—4000ft. (= 914 to 1219m.) [Lecto. K], selected here. *Drège s.n. (I, b.),* South Africa, Eastern Cape province, near Leeuwenfontein, between Sternbergspruit and Colesberg, 4500ft (1372m.) [*n.v.*].

Pachycarpus gomphocarpoides E. Mey., Comm. Pl. Afr. Austr.: 213 [1838]. **Types:** As above.

Xysmalobium gomphocarpoides (E. Mey.) Decne., in DC., Prod. 8: 519 [1844]. **Types:** As above.

Asclepias gomphocarpoides (E. Mey.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 7 [1896]. **Types:** As above.

Gomphocarpus longifolius Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 9, in note [1894] *non* Spreng [1894]. **Type:** *Schonland s.n.,* South Africa, Eastern Cape province, near Grahamstown [Holo. B† Iso. GRA].

Discussion: The leaves, corona-lobe and fruit of this species are all extremely variable. The leaves although typically linear-lanceolate, basal leaves may be broadly lanceolate to elliptic ovate. *W. gomphocarpoides* usually has a corona-lobe that is linear-oblong in shape, more or less truncated apically and with two small dilated auricles basally and laterally on either margin. Follicles can vary from being short and ovoid to long fusiform and falcate. As is often typical of species with small populations widely separated and

scattered over a large distribution range, the variation is great and a number of ecotypes exist some probably requiring nomenclatural recognition. Langley (1980) reports that two specimens he examined differ from the typical form and has assigned varietal status to these. The one specimen (*Bond 1464* from Seven Weeks Poort and housed at NBG) has corona-lobes with lateral auricles missing. We have seen another specimen (Hugo 40) that matches this. Langley proposed calling this variety *dentata*. Langley's other variety, *clavata*, (based on *Compton 8600* collected at Baviaansberg and housed at NBG) is the same as the typical form but with a short tooth on the inner surface. Unfortunately, these names were never validly or effectively published so cannot be used. Langley is probably right in his assertions about these quite distinct ecotypes. We have also encountered a specimen (Acocks 9605) in which the corona-lobes are short, reaching to the bottom of the anther-wings. In this it resembles *W. parviloba*, however, unlike this species the lobes are narrowly linear with small swollen auricles; in *W. parviloba* the lobes are suborbicular and without auricles. We would like to examine more material and also do some field work before we decided to recognize any of these formally. One of the isotypes cited by Meyer (1838) viz. *Drège s.n.*, in hillside grasslands near Shilo, is actually *Parapodium crispum*.

Plants are found growing scattered in open grasslands or in arid parts of the country, where it can often be found in dry sandy river beds. *W. gomphocarpoides* flowers from October to April and occurs at altitudes of between 450 to 2100 meters. Illustrated in Langley 1980

Distribution: South African endemic [Free State, Eastern Cape, Western Cape & Northern Cape provinces] (fig. 21).

Conservation Status: Low Risk (Least Concern). Threatened in some areas, especially the Eastern Cape province which is over populated and in which even marginal areas are heavily exploited for farming.

Representative Specimens: Lesotho: *Coetzee 547*, near Mokhotlong [BLFU, PRE]. **South Africa:** Free State: *Verdoorn 2182*, Groenvlei, Fauresmith [PRE]. Eastern Cape: *Dold 2013 with Cocks*, near Rhodes Village [GRA]; *Tyson 144*, near Murraysberg [SAM]; *Bolus 635*, Oudeberg, near Graaff Reinet [GRA]; *Dyer 1915*, Kikrossch mountains, near Naauwpoort [GRA flowers & fruits]; *Acocks 24539*, Ouberg, Graaff Reinet district [PRE]; *Galpin 2220*, Andriesberg [PRE]; *Acocks 15694*, near Middleburg [PRE]. Northern Cape: *Mogg 8157*, Vryburg [PRE]; *Meyer 57*, Rheebok river, Williston [PRE corona-lobe smaller than normal]; du Preez 2318, Kleinplaas farm, le Roux dam [PRE]; *Germishuizen 6256*, Rhebokuyer farm, Williston district [PRE]; *Germishuizen 6256*, Rhebokuyer farm, Williston district [PRE fruit]. Western Cape: *Bond 1464*, Baviaansberg, Ceres [NBG]. *Compton 8600*, Seven Weeks Poort, Ladismith [NBG]; *Johnson 6802*, Platfontein, Ceres district [PRE]; *Theron 1636*, near Carnarvon [PRE flowers & fruit]; *Hugo 40*, near Oudtshoorn [PRE flowers & fruit]; *Vlok 1350*, Outeniqua mountains near Herold [PRE corona-lobe side auricles very small].

5. *Woodia parviloba* (Bruyns) Nicholas. *Comb. et Stat. Nov.* **Type:** *Bruyns 2945,* South Africa, Western Cape province, near Sutherland, on road verge. [Holo. NBG erroneously cited in protologue as NBC].

Xysmalobium gomphocarpoides Bruyns variety *parvilobium* Bruyns, in S.A. Journ. Bot. 56(1): 127 [1990]. **Type:** As above.

Discussion: Bruyns (1990) treated this taxon as a variety under *W. gomphocarpoides*, with which it is vegetatively almost indistinguishable; although he does also mention that this ranking is up for correction if necessary. It is our opinion that, even though vegetatively very similar to *W. gomphocarpoides*, it is florally quite distinct. The very different corona suggests a different pollination syndrome. The most immediately noticeable difference is the extremely short corona-lobes, hence the name *parviloba*.

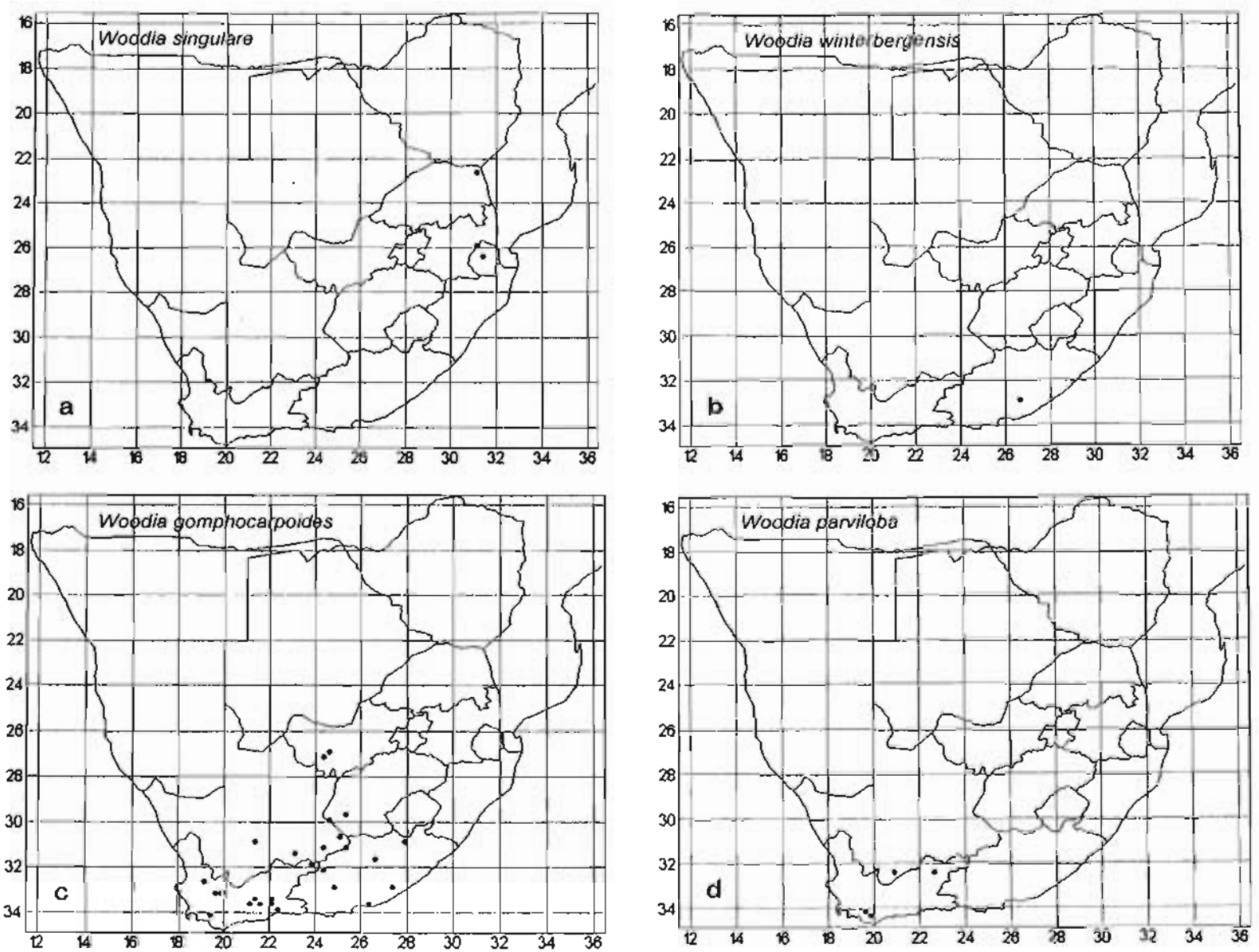

Figure 21. Distribution maps of: a. *Woodia singulare*; b. *W. winterbergensis*; c. *W. gomphocarpoides* and; d. *W. parviloba*.

A list of other differences are tabled below. Based on these differences we have decided to elevate it to specfic level. Interestingly, Schweikardt has written on the Broom specimens (cited below) identified as new at Kew. Obermeyer obviously concured with this and on these same sheets proposed (but never published) the name *Xysmalobium broomii sp. nov. W. parviloba* flowers between about November and January. *Smith 5141* records it at an altitude of 60 meters. Illustrated in Bruyns (1990).

Table 4. Differences between *Woodia gomphocarpoides* & *W. parviloba*

Character	***W. gomphocarpoides***	***W. parviloba***
Corona-lobe length	3.5—5.5mm	1mm
Corona-lobe width	2mm	1.5mm
Lateral-auricles length	0.9—1mm	0mm
Corona-lobe shape	Linear-oblong	Suborbicular
Corona-lobe dimensions	Distinctly taller than broad	About as tall as broad
Corona-lobe proportions	Exceeding the anther-wing base	Never or only just reaching the anther-wing base.
Corona-lobe relationship to gynostegial-column	Gynostegial-column not or only just exposed	Gynostegial-column almost completely exposed
Pollinia Shape	Boomerang-shaped	Tear-drop-shaped

Distribution: South African endemic [Western Cape province only] (fig. 21).

Conservation Status: Low Risk (Near Threatened).

Representative Specimens: South Africa: Western Cape: *Broom s.n.*, Beaufort West [PRE 33006 flowers, fruit & stem-tuber]; *Acocks 24526*, near Greyton, Caledon district [PRE]; *Smith 5141*, Klipdale, Bredasdorp district [PRE]; *Bruyns 3100*, Klipfontein [NBG].

6 ***Woodia fluviale*** (Bruyns) Nicholas. *Comb. Nov.* **Types**: *Bruyns 2823,* South Africa, Western Cape province, Tierberg, ±750m [Holo. BOL. Iso. K, NBG, PRE].

Xysmalobium fluviale Bruyns, in S.A. Journ. Bot. 56(1): 125 [1990]. **Type:** As above.

Discussion: This species is found in a very arid part of the Western Cape, apparently often in seasonally dry water courses or in open areas. Bruyns (1990) states that these inconspicuous plants are normally found creeping and climbing amongst small shrubs, in which case the stems can be 500mm in length. However, if occurring in the open then they are smaller bushy plants with stems shorter than 80mm. This species can be distinguished by its less erect stems and corona-lobes that are ovate with a narrow almost stalked base, acute to rounded upper margins and slight, but distinct, fleshy keel on the outer surface. There are no side basal auricles and the corona only slightly exceeds the style-apex in height. Illustrated in Bruyns (1990).

Distribution: South African endemic [Western Cape Province only] (fig. 22).

Conservation Status: Vulnerable if not approaching endangered. This species is only known from the type collection which was made on the Tierberg near Oudtshoorn. Bruyns (1990) also reports that they are often grazed almost to the root.

Representative Specimens: South Africa: Western Cape: *Dean 467*, Tierberg, Prince Albert district [PRE with flowers & fruit].

7 ***Woodia pearsonii*** (L. Bolus) Nicholas *Comb. Nov.* **Type**: *Pearson 6560,* South Africa, Northern Cape province, Little Namaqualand, on Kamiesberg Plateau, 1500m [Holo. BOL; Iso. GRA, K, NH, PRE & SAM].

Xysmalobium pearsonii L. Bolus, in Ann. S. Afr. Mus. 9: 180 [1913] **Type:** As above. See also N.E. Brown in Diagnoses Africanae: LVI. Kew Bull. 1914: 18 [1914].

Discussion: This species is slightly anomalous in the genus *Woodia* It differs in having stems and leaves more or less inwardly compressed, the upper leaves spiraly arranged, few-flowered inflorescences, a gynostegial-column that is cylindrical, constricted in the middle and longer in relation to the other flower parts, a differently shaped pollinarium, and a keel-less corona-lobe that is very flat basely, but slightly swollen apically and emarginate on the upper margin. However, the totality of its features place it firmly in *Woodia* subgenus *Pseudowoodia*. Bolus (1913), when she named the species after its collector, mentioned similarities to what is now subgenus *Stenostelma*. There is some vegetative similarity between these two taxa, but florally they are quite dissimilar. If a real relationship exists then it is not an immediate one. Illustrated in Langley (1980).

Distribution: South African endemic [Northern Cape province (only known from the Kamiesberg)] (fig. 22).

Conservation Status: Critically Endangered. This species has only been collected once, by Pearson during the *1910—1911 Percy Sladen Memorial Expedition to the Orange River*. Some 87 years later no further collections have been made. It must be considered critically endangered, if not possibly extinct.

WOODIA Schltr. **Subgenus *WOODIA***

Description: *Habit:* Perennial geophytic herb. *Underground organ:* A fleshy, deep-seated stem-tuber. *Stems* usually 1, rarely more, usually unbranched or 1-branched at the base, erect, sometimes almost fleshy, 150—255mm tall, glabrous or uni- to bifariously pubescent. *Leaves* 4—7 pairs per stem, blade linear, ovate-oblong to elliptic, 34—100mm long, 6—32mm wide, thinly leathery to coriaceous, apex acute to obtuse, sometimes with a pungent apiculus, margins usually very undulate, sometimes flat; petiole 8—13mm long. *Inflorescences* 2—8 per stem, produced terminally & laterally at the upper nodes, 4—8-flowered; peduncles sessile to 38mm long; bracts linear-subulate to subulate, 3.4—

9.0mm long. *Flowers* cupulate; pedicels 10—22mm long. *Calyx* shorter to as long as the corolla; lobes linear to lanceolate, 4.5—9.0mm long, 1.5—2.8mm wide. *Corolla* Lobes recurved erect or rotate-erect, oblong, occasionally oblong-ovate, 5.6—12mm long, 2.2—5.6mm wide, apex acute inflexed, margins revolute, adaxial & abaxial surfaces glabrous, apex inflexed, green, creamy green, purplish-brown with pale green margins. *Staminal-corona* arising from the gynostegial-column base; lobes free to the base, erect, dorso-ventrally flattened, transversely-oblong or subquadrate, 2.2—4.0mm long, 2.8—3.4mm wide, trifid, almost deeply 3-lobed with the middle lobe stout, tips incurved & reaching to the level of the style-apex, inner-surface concave & strongly keeled down the middle lobe, middle-lobe lanceolate-subulate, 2.2—3.4mm long, lateral sublobes linear or linear-oblong, shorter than middle lobe, 1.6—2.2mm long, white. *Staminal-column* 2.8—4.5mm tall, constricted below the anther-wings. *Stamens:* anther-wings prominent & triangular; anther-appendages reniform, inflexed onto the style-apex margin. *Pollinaria:* Pollinia subquadrate to rectangular, nearly as broad as long; translator-arms broad & flat with hyaline margins, attached terminally to the pollinia; corpusculum narrowly ovate. *Follicles:* solitary, erect, stoutly fusiform, ovoid to ellipsoid, sometimes almost inflated, 75—120mm long, ±19mm wide, apex acute, surface with short recurved spines 1.0—3.4mm long in longitudinal lines. *Seeds* ovate, 4.5—5.0mm long, 2.2—3.0mm wide, shallowly convex above, shallowly concave below, minutely-tuberculate, dark brown.

Discussion: Plants of this subgenus can be distinguished by their solitary, usually unbranched stems, leaf veins pronounced below, leaf margins usually, but not always, undulate, calyx and corolla erect and sometimes of almost equal length, corona-lobes dorso-ventrally flattened and deeply 3-lobed with the middle lobe longer than the two lateral ones (dinosaur-foot-like).

Distribution: South African endemic [Free State, KwaZulu-Natal & Eastern Cape provinces].

Key to Species:

1a. Peduncles 12 to 38mm long (much longer than the petioles);
sepals as long as or exceeding the petals ..... *W. verruculosa*

1b. Peduncles sessile or up to 17mm long (rarely longer than the petioles);
sepals shorter than the petals ..... *W. mucronata*

8. *Woodia mucronata* (Thunb.) N.E. Br., in Fl. Cap. 4(1): 561 [1907]. **Type**: *Thunberg s.n.*, South Africa, Eastern Cape province, Humansdorp Division, across the Gamtoos river and near the Kromme river [Holo. UPS].

Asclepias mucronata Thunb., Prodr.: 47 [1805]. **Type:** As above.

Gomphocarpus trifurcatus Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 9 [1894]. **Type:** *Flanagan 399,* South Africa, Eastern Cape Province, grassy hills near Komga, 600m [Holo.B† Iso. PRE]. Placed into synonomy here.

Woodia trifurcata (Schltr.) Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 30 [1894]. **Type:** As for *Woodia mucronata* variety *trifurcata*

Woodia mucronata (Thunb.) N.E. Br. variety *trifurcata* (Schltr.) N.E. Br., in Fl. Cap. 4(1): 562 [1907]. **Type:** As for *Woodia mucronata* variety *trifurcata.*

Woodia trifurcata (Schltr.) Schltr. variety *planifolia* Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 39 [1895]. **Type:** *Schlechter 3799,* South Africa, Mpumalanga Province, in grasslands near the Oliphant river, 1524m, 26.11.1893 [Holo. B†]. Placed into synonomy here.

Pachycarpus marginatus E. Mey., Comm. Pl. Afr. Austr.: 213 [1838]. **Types:** *Drège 2224,* South Africa, Eastern Cape province, Uitenhage division, Addo. (300 to 450 meters) [Iso. *n.v.*]. *Drège s.n. (IV, C, c),* South Africa, Eastern Cape province, in grasslands, near Galgebosch, alt. 800ft. (= 244 meters) [Iso. *n.v.*]. *Drège s.n. (V, b),* South

Africa, Eastern Cape province, between Chalumna & Buffelriver, alt. 1500ft. (= 457 meters) [Iso. *n.v.*]. *Drège s.n. (V, b),* South Africa, Eastern Cape province, Nieuweveld, near Bokpoort, alt. 3500ft. (= 1067 meters) [Iso. *n.v.*].

Xysmalobium marginatum (E. Mey.) Dietr., Syn. Pl. 2: 902 [1840]. **Types:** As for *Pachycarpus marginatus*

Gomphocarpus marginatus (E. Mey.) Decne., in DC. Prodr. 8: 560 [1844] *non* Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 33 [1895]. **Types:** As for *Pachycarpus marginatus*

Woodia marginata (E. Mey.) Schltr., in Journ. Bot.: 456 [1896] and in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Types:** As for *Pachycarpus marginatus*.

Gomphocarpus undulatus Turcz., in Bull. Soc. Nat. Moscou 21(1): 259 [1848] *non* Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 10, below 300ft (= 91m) [1894]. **Type:** *Ecklon 36,* South Africa, Eastern Cape province, Alexandria Division, Oliphantshoek forest [Iso. MEL *fide* Forster (1994)].

Xysmalobium linguaeforme Harv. ex Weale, in Journ. Linn. Soc. 13: 50 [1873]. Placed into synonomy here.

Discussion: In this species the leaf margins are flat to very undulate, inflorescences vary from sessile or with peduncles up to 18mm long, sepals are shorter than the petals and the corona-lobes are deeply 3-lobed. This species bears some superficial resemblance to *Parapodium crispum* and *Woodia gomphocarpoides*, however, the structure of the corona immediately sets it apart from these. N.E. Brown (1907) divided this taxon into var. *mucronata* and var. *trifurcata* (sinking Schlechter's *Gomphocarpus trifurcatus*). Variety *trifurcata* was separated from var. *mucronata* on the basis of having the leaves and flowers larger, and the two lateral sublobes of the corona-lobe longer and broader. However, specimens we have examined intergrade between the two extreme and we have found no distinct continuity. As a result, we have been unable to uphold the divison of this taxon into two varieties. Plants can be found growing in open often annually burned grasslands at altitudes of between 30 and 1500 meters.

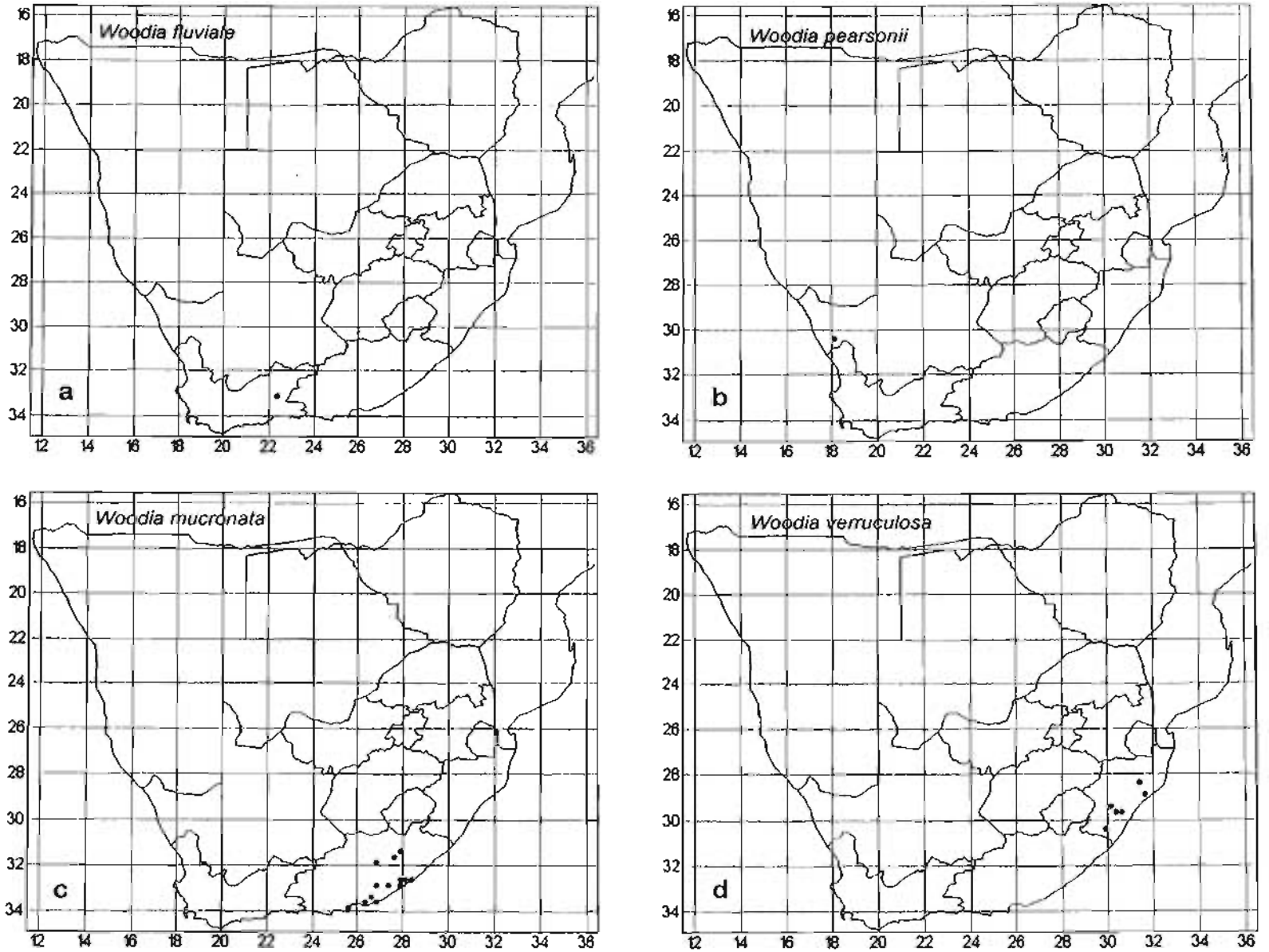

Figure 22. Distribution maps of: a. *Woodia fluviale*; b. *W. pearsonii*; c. *W. mucronata* and; d. *W. verruculosa*.

Distribution: South African endemic [Free State (where it borders the Eastern Cape) & Eastern Cape provinces] (fig. 22).

Conservation Status: Low Risk (Near Threatened). Vulnerable in many areas.

Representative Specimens: South Africa: Eastern Cape: ; *Nicholas 2802 with Dold*, Grahamstown [UDW]; *Flanagan 2704*, between Cala & Elliott [PRE]; *Galpin 1807*, near Queenstown [PRE]; *Giffen 990*, near Alice [UFH]; *Wood s.n., sub Galpin 3385*, near East London [PRE]; *Pegler 572*, Umtata Kentani [PRE]; *Sim 278*, King Williams Town [PRE]; *Bolus 10186*, Between Cala & Elliott [PRE]; *Wood 3385*, East London [PRE]; *Acocks 17881*, near Alexandria [PRE]; *Acocks 23778*, Barville Park, Bathurst [PRE].

9. *Woodia verruculosa* Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 31 [1894]. **Type**: *Wood 4079*, South Africa, KwaZulu-Natal province, grassy hills near Camperdown, 650 meters. Oct. 1888 [Holo. B† Iso. NH, SAM].

Discussion: In this species the leaf margin is flat, inflorescences are pedunculate, sepals are as long as or even longer than the petals and the corona-lobes are deeply 3-lobed (fig. 23). The Zulu name for this plant is *uShangagube*, the English name is Bitter cress. The plant is apparently used as a vegetable. Plants flower between October and February, and are found at altitudes of between 600 to 1000 meters.

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape (border region with KwaZulu-Natal) provinces] (fig. 22).

Conservation Status: Low Risk (Near Threatened), following Scott-Shaw (1999). Seldom encountered, must be considered threatened.

Representative Specimens: South Africa: KwaZulu-Natal: *Nicholas 943 with Ackhurst*, Pietermaritzburg [CPF]; *Nicholas 1075*, Ngoya Forest [CPF]; *Gerstner 4259*, Zondela, Mahlabathini district [NH]; *Gardiner s.n.*, Howick [NU 56916]; *Gerstner 4242*, amaBedhlane, Mahlabathini district [NH]; *Wood 4966*, near Camperdown [PRE];

Figure 23. *Woodia verruculosa*: a. Whole plant showing habit (200mm tall); b. Close up of flowering stem and; c. Close up of flowers. Photographs by A. Nicholas.

Wood 5012, near Howick [PRE]; *Brayshaw 70*, Oribi airfield [NU]; *Shirley s.n.*, Thornville [NU 32387]. Eastern Cape: *Tyson 2173*, mountains near Clydesdale [n.v. *fide* N.E. Brown 1907].

Excluded Southern African Names:

Woodia marginata Schlechter = ***Woodia mucronata* (Thunb.) N.E. Br.**

Woodia trifurcata (Schltr.) Schltr. = ***Woodia mucronata* (Thunb.) N.E. Br.**

Woodia trifurata Schltr. var. *planifolia* Schltr. = ***Woodia mucronata* (Thunb.)**

Woodia trilobata Schtlr. = **Tropical African species generic status unknown doubtfully *Woodia*.**

STATHMOSTELMA K. Schum., in Bot. Jahrb. 17: 129 [1893]. **Type species:** *Stathmostelma gigantiflorum* K. Schum.

Description: *Habit:* Stout or slender perennial geophytic herb; with milky latex. *Underground organ:* A narrow to stout deep-seated (0.3—2.0m or more long) stem-tuber. *Stems* 1 to many, simple or branched, erect to spreading-erect, 60—1500mm tall, glabrous or minutely pubescent. *Leaves* opposite, simple, entire, spreading to spreading-erect, sessile or petiolate; lamina usually linear, linear-lanceolate, lanceolate to oblong, sometimes elliptic, 30—250mm long, 1—40(-120)mm wide, apex usually acute, sometimes obtuse, base cuneate, rounded to truncate, margins smooth & flat, sometimes slightly revolute, usually with white hairs on the margins & midrib below, occasionally pubescent on both surfaces; petiole sessile or up to 30mm. *Inflorescences* umbel-like, erect, produced terminally or laterally at the nodes or both, extra axillary, 2—15-flowered; peduncles 5—300mm long, minutely to densely pubescent, sometimes with all inflorescences on the same plant held at the same level; bracts usually filiform,

sometimes lanceolate to ovate, often caducous. *Flowers* red, red-brown, pink, orange-red, yellow, chrome-yellow, yellowish green, whitish or green, occasionally speckled with purple; pedicels 10—50(-80)mm long, pubescent. *Calyx* 5-merous; lobes linear-lanceolate, lanceolate, ovate, broadly ovate to ovate-oblong, 2—16mm long, 1—11mm wide, apex acute to subacute, subglabrous to pubescent. *Corolla* 5-merous, erect, spreading or reflexed, rarely campanulate, divided almost to base; lobes lanceolate, ovate, oblong, oblanceolate, obovate to elliptic, 6—30mm long, (3-)8—15mm wide, apex acute, subacute to obtuse, margins flat to revolute, abaxial surface glabrous, subglabrous or pubescent especially towards apex, adaxial surface sometimes minutely papillate at the base. *Staminal-corona* in 1-series, 5-merous, yellow, orange, red, pink, white, green & sometimes speckled with purple, arising above the gynostegial-column base; lobes erect, ±fleshy, dorso-ventrally flattened, cucullate to sinuously cucullate, taller than broad, 4—14(-20)mm tall, 1.5—4.0(-7.0)mm wide, with a distinct sinus or lobes almost solid, apex truncate to subtruncate, entire, level with to greatly exceeding the style-apex, outer upper apex usually rounded, inner-upper margin produced into two inwardly or upwardly dentate appendages, 1—4mm long, 2—3mm wide, with or without a 1.5—4.0mm long, 0.6—1.5mm wide sinus appendage. *Staminal-column* sessile or with stipe up to 3mm; anther-wings convexly rounded, with or without contorted basal tails, 1—6mm long; anther-appendages suborbicular, 0.5—3.0mm long, inflexed over the style-apex margin. *Pollinaria*: Pollinia solitary, pendulous in each anther-sac, flattened, oblong; translator-arms, in two distinct parts, proximal portion contorted & membranous, distal portion filiform then broadening abruptly into a flange-like tip that overlaps & attached apically to the pollinia; corpusculum ovoid to subglobose. *Style-apex* truncated. *Follicles* solitary, fusiform to ovoid, sometimes slightly inflated, 50—160mm long, 5—50(-80)mm wide, apex beaked, surface smooth or with several weak longitudinally ridges, glabrous to densely hairy. *Seeds* ovate, bifacial, dorso-ventrally flattened, 3—8mm long, 2—4mm wide, margins narrowly winged, surface verrucose; coma 40mm long.

Discussion: This genus, which is an African endemic, has only recently been recorded from the flora of southern Africa region. *Stathmostelma* consists of 17 species, distributed in the tropical eastern side of the continent from Botswana north to Ethiopia (Goyder, 1998). Unlike other genera in the subtribe in southern Africa the flowers are often brightly colored, only really being matched in South Africa by the yellow flowers of *Aidomene aurea* and some *Schizoglossum* species. In tropical Africa, the flower color of *Stathmostelma* is also consistent with *Margaretta* a genus to which it has many similarities and possibly also a common ancestory. The flowers are often very large. Although the peduncles can be quite short in some instances they are usually extremely long (as in *A. aurea.*) and sometimes all the flowers/inflorescences on the same plant are held at more or less the same level, (viz. corymbose); a character sometimes seen in *Margaretta*, *Trachycalymma* and *Pachycarpus* (e.g. *P. schinzianus*) but otherwise not commonly encountered. The sinuously cucullate corona-lobes are also unique, as are the pollinaria with their two portioned highly ornate translator-arms and smallish pollinia. In fact, when Schumann (1893) first described this genus it was largely based on the unusual structure of the pollinarium. The pollinaria are also some of the largest seen in the subtribe Asclepiadinae. Beside flower color and peduncle length *A. aurea* and *Stathmostelma* are quite different in almost all other aspects. Plants are found in grasslands, often in seasonally waterlogged situations.

1. ***Stathmostelma fornicatum*** (N.E. Br.) Bullock in Kew Bull. 8: 55. (1953). **Subsp. *fornicatum*. Type:** *McClounie 81,* Malawi, Mwanemba (Nyika Plateau), Feb./Mar. 1903, 2400m [Holo. K *fide* Goyder 1998].

Asclepias fornicatum N.E. Br., in Kew Bull. Misc. Inform. 1906: 250 [1906]. **Type:** As above.

Discussion: This species is distinguished by its linear leaves, untailed anther-wing bases, chrome-yellow to greenish yellow colored flowers, and corona-lobes never more than

8mm tall with appendages free not fused and sinus very shallow (almost non existent). The species is divided into two subspecies: the type species above and subspecies *tridentatum* Goyder (1998) which only occurs in Tanzania and has an appendage in the corona-lobe sinus. Photography and distribution map in Goyder (1998).

Distribution: African endemic. In southern Africa found only in Botswana. Otherwise occurring north to Malawi (fig. 25).

Conservation status: Data Deficient. Probably rare in Botswana.

Representative Specimens: Botswana: *Venter, Hahn & Archer 163,* Pandamatenga [PRE].

STENOSTELMA Schltr., in Bot. Jahrb. 18(5). Beibl. 54: 6 [1894]. **Type species:** *Stenostelma capense* Schltr.

Krebsia Harv., Gen. S. Afr. 2nd edn. 2: 233 [1868] *non* Eckl. & Zeyh., Enum. Pl. Afric. Austral.: 179 (= Fabaceae) [1836]. **Type Species :** *Krebsia stenoglossa* (Schltr.) Schltr. (*fide* Dyer, 1975)

Gomphocarpus R. Br. section *Krebsia* (Harv.) Schltr., in Journ. Bot. 32: 257 [1894]. **Type Species :** *Gomphocarpus stenoglossus* Schltr.

Xysmalobium R. Br. section *Stenophyllum* K. Schum., in Engler et Prantl. Pflzfam. 4(2): 232 [1895]. **Type species:** *Xysmalobium involucratum* (E. Mey.) Decne. Selected here.

Saxymolbium Bullock ex Field. Name not published but widely used. Cited in Langley, M.Sc. thesis: 70 [1980].

Description: *Habit:* Perennial geophytic herbs; with milky latex. *Underground organ:* A fleshy napiform or carrot-shaped stem-tuber. *Stems* usually solitary, rarely up to 3, unbranched or sparingly branched from the base, usually erect, sometimes slightly decumbent, 100—500mm tall, bifariously pubescent or pubescent all over. *Leaves*

opposite, simple, erect to spreading erect, sessile, subsessile or distinctly petiolate; lamina linear, oblong-linear to narrowly lanceolate, 36—130mm long, 1—9mm wide, apex acute to sharpely pointed, base cuneate to tapering, margins flat & revolute, midvein very prominent & slightlyscabrid, adaxial & abaxial surface glabrous to glabrate; petiole 1—4mm long. *Inflorescences* 1—10 per stem, erect, umbel-like, globose to subglobose, produced terminally & laterally at the nodes, 3—32-flowered; sessile, subsessile or peduncles 2—36mm long, pubescent; bracts linear-subulate, 2.2—10.0mm long, 0.5—1.0mm wide. *Flowers* green, greeny yellow, creamy green, whitish, sometimes tinted purple, reflexed rotate; pedicels 2.2—13.0mm long, sometimes somewhat stout, puberulous. *Calyx* 5-merous, reflexed or spreading erect; lobes 1.6—5.6mm long, 1.0—1.7mm wide, apex acute, adaxial surface glabrous, abaxial surface glabrous or pubescent; septal glands 0.15—0.1mm tall. *Corolla* 5-merous, more or less divided to the base, erect ot spreading erect (with lobes concave in the basal half convex & recurved revolute apically to concave throughout) or very reflexed; lobes oblong-lanceolate, oblong-ovate to elliptic, 2.0—6.8mm long, 1.2—3mm wide, apex subacute to obtuse, sometimes with a terminal oblique notch & tips up or incurved, margins sometimes slightly revolute, adaxial surface glabrous, rarely glabrate, abaxial surfaces glabrate to glabrous & sometimes slightly shiny apically. *Staminal corona* 5-merous, arising at the base of the gynostegial-column or 0.75—1.5mm up the gynostegial-column; lobes free, erect, fleshy or hollow basely, closely apressed to the gynostegial-column, ovoid, tear-drop shaped, ovate-lanceolate, linear-falcate, 0.6—9.0mm long, 0.75—2.2mm wide, apex acute, shortly acute & straight to long subulate recurved & hooked at the tip, not or greatly overtopping the gynostegial-column in which case they are exerted beyond the corolla, inner surface concave channeled, flat, slightly rounded or with a hidden hollow inner cavity, outer surface rounded, sometimes with a ^-shaped thickening below the apex, slightly gibbous or prominently & acutely keeled, rarely with a broadly rounded transverse appendage near the base, simple laterally near the base or with protruding

swollen auricles, white, yellowish, purple to brown usually with white margins. *Staminal-column* 2—4mm tall, cylindrical or barrel-shaped (constricted below & above), sometimes stipitate, sometimes with papillate glands just above the corpusculum. *Stamens:* Anther-wings triangular broadest at the base or in the middle, 0.5—2.2mm long, 0.45—0.9mm wide, with a medial or subterminal notch; anther-appendages ovate, broadly ovate, rhomboid-ovate or elliptic-ovate, 0.55—0.8mm long, 0.4—1.0mm wide, apex acute to obtuse, inflexed over the rim of the style-apex if flat, erect if style-apex conical. *Style-apex* small, truncated, pentagonal, creater-like & not exceeding the anthers or rarely conical & exceeding the anthers, sometimes with papillate glands just above the corpusculum. *Pollinaria:* Pollinaria solitary, pendulous in each anther-sac, elongated club-shaped or obliquely deltoid; translator-arms long & thin, attached terminally to the pollinium; corpusculum ovoid. *Follicles* usually solitary, occasionally paired, narrowly fusiform, not inflated, equally tapering at both ends, 65—176mm long, 6—17mm wide, apex acuminate, pointed, surface smooth & thin, sometimes with about 6 slight longitudinal ridges bearing small subulate processes 1.7—3.4mm long; fruiting pedicel straight & erect. *Seeds:* bifacial, dorso-ventrally flattened, broadly ovate, 5.5—6.5mm long, 3.2—4.5mm wide, slightly convex on the upper surface, slightly concave on the lower surface, margins sometimes broad, surface minutely rugulose.

Discussion: We have considerably enlarged the circumscription of the *Stenostelma*. To the two species traditionally placed here we have added four others; three previously placed in *Xysmalobium* and one in *Schizoglossum*. Most species have a corolla that is erect with the reproductive structures hidden from prospective pollinators. In *S. capense* and *S. corniculatum* the corolla is almost globose and cage-like around the inflated basal portion of the gynostegial-column, it is then concave above this and reflexed to almost replicate at the tips, the upper portion being curved clock-wise when viewed from above. In *S. involucratum* and *S. zeyheri* the corolla is reflexed so that the gynostegial-column is exposed and presented to the prospective pollinators. In *S. involucratum*, *S. zeyheri*, *S.*

carinatum and *S. periglossoides* the corona-lobes are simple and more or less ovoid or tear-drop-shaped, without lateral fleshy auricles, never hollow and the attenuate tips level with or below the style-apex (*S. periglossoides, S. involucratum* and *S. zeyheri*) or just over top the style-apex (*S. carinatum*), they are never extended and curled at the tips, so do not extend beyond the corolla.. In *S. capense* and *S. corniculatum* the corona-lobes are not really simple, but have two lateral fleshy wings or auricles near the base, and very long and pointed above this with the tip projecting beyond the corolla. The style-stigma-head of these two species also bears fleshy glands just above the point where the corpuscula are attached; these glands have darkened tips. So far we have only encountered these particular types of gland in *Xysmalobium*. We thus agree with Kupicha (1984) that *Schizoglossum periglossoides, Schizoglossum umbelluliferum* (placed into synonomy under *Stenostelma involucratum* here) and *Schizoglossum aciculare* (placed into synonymy under *Stenostelma capense*) should be included in *Stenostelma*. She also suggests that *Lagarinthus eustegioides* E. Mey. (syn. *Schizoglossum crassipes* S. Moore) and *Schizoglossum orbiculare* Schltr., be included in *Stenostelma*. Schlechter (1895) suggests that *Schizoglossum orbiculare* is related to *Schizoglossum umbelluliferum* and *Schizoglossum periglossiodes* (here placed under *Stenostelma involucratum* and *S. periglossoides*). However, going on the description, we agree with N.E. Brown (1907) that it is probably similar to *Lagarinthus eustegioides* (syn. *Schizoglossum crassipes* S. Moore) and we intend to place it into synonomy under this species (paper in preperation). *Lagarinthus eustegioides* is not part of *Stenostelma*.

Schumann (1895) when he first described *Xysmalobium* section *Stenophyllum* included four species under it: *X. dissolutum* (Schltr.) K. Schum., *X. involucratum* (E. Mey.) Decne., *X. holubii* Scott-Elliot (erroneously cited as *X. holubyi* a Schlechterian name) and *X. heudelotianum* Decne. We have decided to select *X. involucratum* as the type of this section. *X. dissolutum* (originally described in the genus *Asclepias*) now belongs in the genus *Trachycalymma*. *X. heudelotianum* and *X. holubii*, both tropical

African species, resembling S. involucratum florally, but not vegetatively. Other tropical African species that might fall here include *X. reticulatum* N.E. Br. and *X kaesneri* S. Moore. The floral similarity of these tropical species may be due to convergence, a hypothesis supported by the fact that, unlike the southern African species (except *S. zeyheri*), the anther-wings are broadest at the base and not in the middle.

Distribution: Southern African endemic: Lesotho, South Africa [Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape & Northern Cape provinces] and Swaziland.

Key to Species:

1a Corolla reflexed 2

1b Corolla erect or spreading erect 3

2a Anther-wings broadest at the base, gynostegial-column stipitate ..... *S. zeyheri*

2b Anther-wings broadest at the middle, gynostegial-column sessile .. *S. involucratum*

3a Peduncles sessile ..... S. *periglossoides*

3b Peduncles 2 to 24mm long. 4

4a Plants 200 to 280mm tall 5

4b Plants 75 to 160mm tall, corona-lobes suborbicular or oblong 6

5a Peduncles 4 to 7mm long ..... *S. carinatum*

5b Peduncles 10 to 24mm long ..... *Sp. Nov. b*

6a Tips of corona-lobes obtuse, not protruding from the flower ..... *Sp. Nov. a*

6b Tips of corona-lobes sharply pointed & greatly protruding from the flower 7

7a Pedicels 2mm long; corona-lobes 6.75 to 9.0mm long; anther-wings broadest at the base; style-head truncate with margins undulate ..... S. *corniculatum*

7b Pedicels 3.5 to 6.75mm long; corona-lobes ±5.5mm long; anther-wings broadest just above the base; style-head pyramidal ..... S. *capense*

1 ***Stenostelma capense*** Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 6 [1894]. **Type**: *Flanagan 1693,* South Africa, Northern Cape province, near Kimberly, 1300m, Dec. 1892 [Holo. B† Iso. PRE].

Schizoglossum capense (Schltr.) Huber, in Mitt. Bot. Staatssamml. München 4: 35 [1961]. **Type:** as above.

Gomphocarpus stenoglossus Schltr., in Journ. Bot. 32: 257 [1894]. **Type:** *Barber 293*, Eastern Cape province, Kreilis country [Holo. B± Iso. GRA]

Krebsia stenoglossa (Schltr.) Schltr., in Journ. Bot. 32: 450 [1896]. **Type:** As above.

Schizoglossum aciculare N.E. Br., in Fl. Trop. Afr. 4(1): 363 [1902]. **Type:** *Lugard 82,* Botswana, Ngamiland, near Kgwebe [*n.v.*].

Discussion: This species differs from its nearest relative, *S. corniculatum,* in having the corona-lobes shortly stalked at the base, and lateral eared just above this, then long and tapering to a point, on the inner surface below the margins do not quite meet instead leading to an enclosed inner cavity inside the lobe (not an uncommon feature in many asclepiads) and enveloped by a complete tissue surface that starts at the auricles. The anther-wings are broadest just above the base and hooked upwards. The anther-appendages are undulate along the margin. The translator-arms are quite broad, unequally

thickened and almost as long as the pollinia. The pollinia are shaped like the end of a hockey stick. This species is, apparently, fairly common in northern Namibia and the northern Kalahari, where it is still widely eaten as a food during the rainy season. In this region it is known as *mpungu* by the Kwangali and *//aei* by the San (Fox & Norwood Young, 1982). On a specimen (*Biggs s.n.* in PRE) collected in Namibia the local name *Gwarib* is also recorded. The corpusculum is small (0.28 to 0.3mm long). The stigma glands are slightly hooked. The leaves of this widespread species are extremely variable and in the east sometimes resemble those of the genus *Bruynsia*. Differences between *Bruynsia* and *Stenostelma* are discussed in Nicholas *et al.* (in press). Although occuring in arid regions of the subcontinent this species usually, but not always, grows in areas that are seasonally moist, such as pans and flood plain terraces, also occuring on rocky hillsides. Said by collectors to be scarse. Plants flower from September to April, peaking January-February, and occur at altitudes of between 900 and 1500 meters. Illustrated in Bruyns 1995.

Distribution: Southern African endemic. Namibia, South Africa [Gauteng, Mpumalanga, Free State, Eastern Cape & Northern Cape provinces] and Swaziland (fig. 24). In Namibia it is apparently widespread, but relatively rare in the north (Bruyns, 1995).

Conservation Status: Threatened in some areas especially in South Africa. Will soon be at risk.

Representative Specimens: Namibia: *Dinter 5272*, Otavi [NU, PRE with stem-tuber]; *Killick & Leistner 3364*, Mpilila Island, Zipfel, eastern Caprivi [PRE]; *Biggs s.n.*, Etosha National Park [PRE]; *Schoenfelder 926*, near Grootfontein [PRE]; *Schoenfelder 18*, without precise locality [PRE pencil drawing of stem-tuber] **Botswana:** *Smith 2584*, Toromoja on Boteti river [PRE]; *Mogg 8563*, without precise locality [PRE]. **South Africa:** Gauteng: *Schlechter 3689*, Magaliesberg [NH two specimens, PRE]; *Theiler 12662*, Wonderboom [PRE with stem-tuber]; *Barker 815*, Beestekraal Game Reserve, Brits [PRE]. Mpumalanga: *Thorncroft 1174,* Lomati Valley [GRA]; *Burtt Davy 955*,

Ermelo [NH]. Free State: *Gemmell s.n.*, Bloemfontein [BLFU 7621]; *Pont 666*, Kroonstad [BLFU]; *Hanekom 570*, Heuwelsig, west of Dan Pienaar [PRE]; *Verdoorn 2380*, Fauresmith [PRE]; *Van Rensberg 161*, Lusthof farm, Edenville [PRE]; *Henrici 5217*, Driekop farm, Fauresmith district [PRE two specimens one with a pencil drawing of the flower, corona-lobe & pollinarium the other with fruit]; *Acocks 23839*, Springfontein district [PRE]; *Acocks 23796*, Bell's Pass, Winburg district [PRE]; *Smith 575*, Karoo Flora Reserve [PRE with flowers & fruit]; *Smith s.n.*, Bloemfontein [PRE 58262]; *Pont 666*, Kroonstad [PRE two sheets one with flowers & fruit the other with stem-tuber]; *Acocks 20980*, near Wolwehoek Station [PRE]. Eastern Cape: *Acocks 1750*, Jakkalsfontein, Zwagershoek [PRE]; *Acocks 20074*, near Whittlesea [PRE]; *Schönberg sub Galpin 2572*, Lesseyton Nek [PRE]. Northern Cape: *Acocks 1406*, Dorstfontein, Kimberley district [PRE]; *Acocks 16332*, near Schoombie [PRE]; *Verdoorn 1507*, Grootfontein [PRE fruit only]. **Swaziland:** *Bolus 12115*, near Mafutane [*fide* N.E. Brown 1907].

2. *Stenostelma corniculatum* (E. Mey.) Bullock, Kew Bull.: 47 [1952]. **Type:** *Drège s.n. (V, a),* South Africa, Eastern Cape province, hillside grasslands at Katrivier, 762m. [Holo. B†]; *Drège 3423,* South Africa, Eastern Cape province, in rough area near Table Mountain, 1524m. [Holo. B†].

Lagarinthus corniculatus E. Mey., Comm. Pl. Afr. Austr.: 208 [1838]. **Types**: As above.

Gomphocarpus corniculatus (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Types**: As above.

Krebsia corniculata (E. Mey.) Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 41 [1895]. **Types:** As above.

Schizoglossum corniculatum (E. Mey.) R.A. Dyer, in Bothalia, 10(2): 363 [1971].

Type: As above.

Discussion: This species differs from *S. capense* in the corona-lobes being virtually sessile with the lateral auricles basal and positioned more towards the outer keel, above this, and more towards the inner surface, the lobe is ovate in shape and then sharply pointed above, the outer keel is more angled and the inner surface has a large central depression (but no hidden inner cavity). The anther-wings are broadest at the base, hooked upwards and with a notch. The anther-appendages are not undulate on the margin. The style-apex is truncate, 5-crenulate and deeply depressed at the very top. The translator-arms are thin more or less equally thickened and half as long as the pollinia. The pollinia is shaped like the head of a gold-club putter. The corpusculum is small (about 0.3mm). The stigma glands are straight, mammalia-like and pointing downwards. Like *S. capense*, vegetatively this species can resemble species of *Bruynsia*, in particular *B. eminens* (see *Lambrechts 125* and *without collector & number* PRE 10311). Plants are found growing in stony grasslands. Said by collectors to be rare. *S. corniculatum* flowers from November to March, peaking in December-January, and occurs at altitudes of between 400 and 1700 meters.

Distribution: Southern African endemic. Lesotho and South Africa [Northern, North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape & Western Cape provinces] and Swaziland (fig. 24).

Conservation Status: Vulnerable to threatened in some areas, particularly Gauteng. This species will soon be at risk.

Representative Specimens: Lesotho: *Coetzee 551*, between Khubela & Sengu [BLFU]; *Dieterlen 1179*, Mafeteng district [PRE]. **South Africa:** Northern: *Without collector or number*, Grouifontein [PRE 81]. North West: *Germishuizen 595*, Buffelskloof farm, Buffelskloof [PRE]; *Leendertzz 12665*, Zeerust [PRE]; *Louw 1625*, Klington, Potchefstroom district [PRE]. Gauteng: *Bredenkamp 427*, Suikerbosrand [PRE]; *Theiler*

12008, Onderstepoort [PRE]; *Mogg s.n.*, Fairy Glen, Pretoria [PRE 51435]; *Codd 9228*, Lynnwood Pretoria [PRE]; *Smith 1407*, between Fountains & Pretoria [PRE]; *Without collector & number*, Onderstepoort [PRE 10311]. Mpumalanga: *Thorncroft 277*, near Barberton [NH]; *Bredenkamp 1867*, Albatros koppie, Manyeleti Game Reserve, Pilgrims Rest [PRE]. Free State: *Roberts 2979*, Thaba 'Nchu mountain [PRE]; *Hanekom 571*, Heuwelsig near Dan Pienaar [PRE] KwaZulu-Natal: *Gerstner s.n.*, Eshowe-Entumeni road [NH 22439]; *Codd 8243*, near Fugitives Drift [PRE]; *Gerrard 2162*, Buffalo River [NH]. Eastern Cape: *Rudatis 56*, Buffelsvlei, Middleburg district [STE]; *Galpin 8286*, Maderia Hill, Queenstown [PRE]. **Swaziland:** *Barrett 241*, Tshaneni [PRE].

3 ***Stenostelma periglossoides*** (Schltr.) Nicholas. *Comb. Nov.* **Type**: *Schlechter 4142*, South Africa, Gauteng province, Pretoria, alt. 1463m, 05.01.1894 [Lecto. PRE three specimens. Isolecto. MEL, *fide* Forster (1994), NH with drawing]. Selected here. *Schlechter 4027*, South Africa, Mpumalanga province, marshy areas near small Oliphant river, 1615m, 21.12.1893 [Syn. *n.v.*].

Schizoglossum periglossoides Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 20 [1895].

Types: As above.

Discussion: N.E. Brown (1907) mentioned the closeness of this species to what is now *S. capense* and *S. carinatum*. Like some of the other species of this genus it has a small napiform or carrot-like stem-tuber, graminaceous habit, erect leaves, peduncles sessile or very short, subglobose inflorescence with over 10 flowers, corona-lobes fleshy tear-drop-shaped with a slight gibbosity on the outer surface, and anther-wings triangular and broadest at the middle with a distinct notch along its length. Like *S. capense* and *S. corniculatum* the corolla is erect and campanulate, and hides the gynostegial-column. However, it differs from these species in having the corona-lobe much smaller and not exceeding the style-apex (reaching about halfway up the gynostegial-column) or almost,

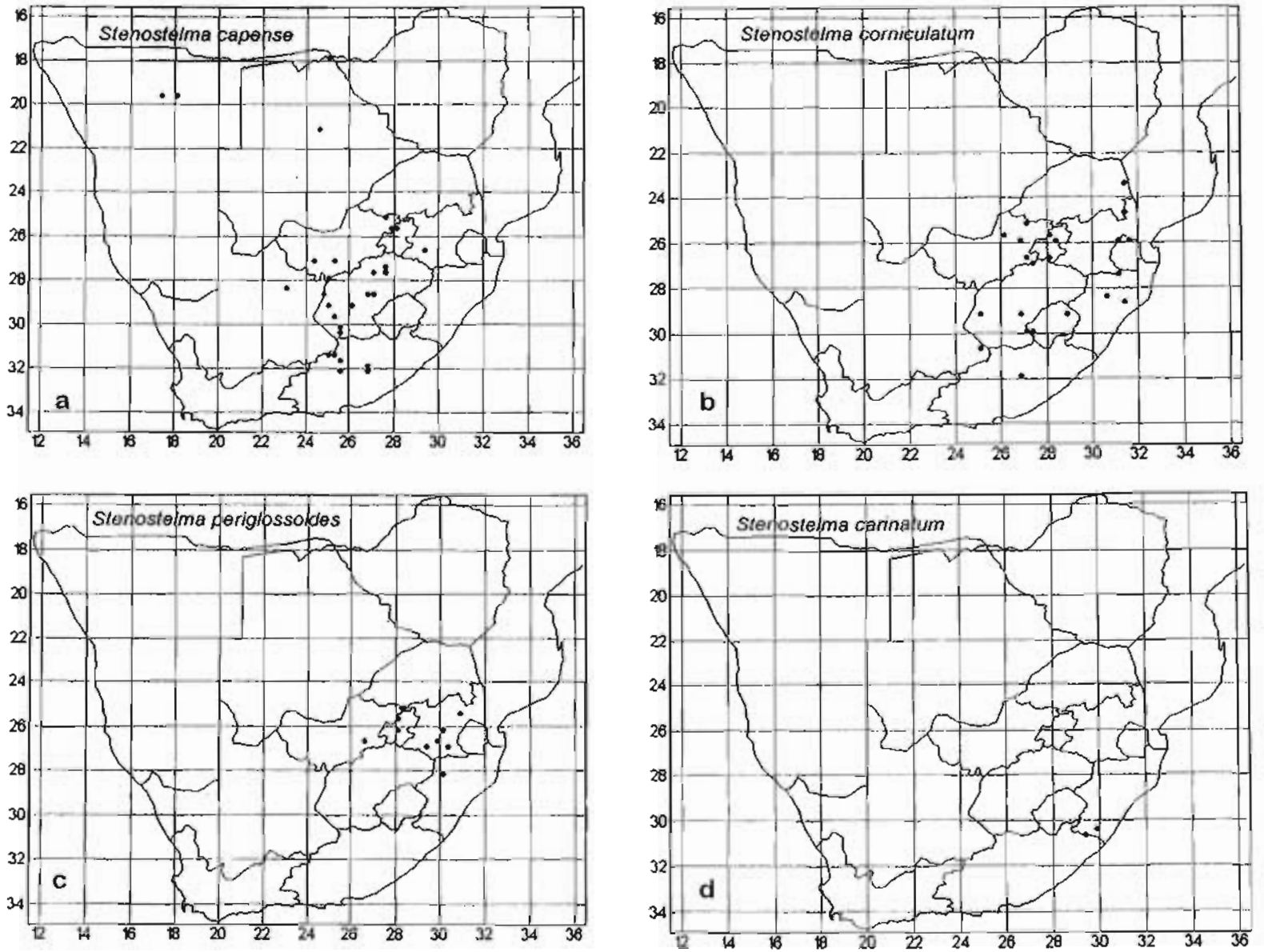

Figure 24. Distribution maps of: a. *Stenostelma capense*; b. *S. corniculatum*; c. *S. periglossoides* and; d. *S. carinatum*.

but not quite reaching the style-apex. The corona-lobes are more solid and the apex is not extended. In these characters the corona-lobes are more like those of *S. carinatum* and *S. involucratum*, with which it compares in other floral features. These intermediate species makes the division into infrageneric taxa unfeasible. Plants are found in very damp situations. *S. periglossum* flowers from December to January, rarely as early as September, and occurs at altitudes of between 1200 to 1800 meters.

Distribution: South African endemic [Gauteng, Mpumalanga & KwaZulu-Natal provinces] (fig. 24). So far this species has only been collected once in KwaZulu-Natal in the north near the border with Mpumalanga.

Conservation Status: Vulnerable. Few collections made during the last 20 years. Particularly endangered in Gauteng province.

Representative Specimens: South Africa: Gauteng: *Burtt Davy 3156*, Beginsel farm, near Standerton [PRE]; *Gilfillan sub Galpin 6231*, Doornfontein [PRE]; *Pole Evans s.n.*, Rietvlei, Pretroia [PRE]; *Gilfillan sub Galpin 7861*, Bezuidenhout Valley [PRE]; *Codd 9889*, Boksburg, near Birchleight [PRE]; *Codd & Bruce 3633*, near Roodekop Station, Germiston district [PRE]; *Hutchingson 2621*, between Irene & Johannesburg [PRE]. Mpumalanga: *Burtt Davy 955*, near Ermelo [NH] & near Blesbokspruit, Standerton [PRE]; *Balsinhas 2980*, Nooitgedacht Research Station, near Ermelo [PRE]; *Rademacher 10411*, Carolina [PRE]; *Burtt Davy 3322*, Standerton [PRE]; *Acocks 21949*, near Standerton [PRE]; *van Duijn 15833*, Kranspoort [PRE]; *Pole Evans s.n.*, Nelspruit [PRE 51295]. KwaZulu-Natal: *Johnstone 254*, Hattingspruit [NU with stem-tuber].

4 ***Stenostelma carinatum*** (Schltr.) Bullock , in Kew Bull. 1956: 568 [1956]. **Type**: *Tyson 1439*, South Africa, Eastern Cape province, wet grassland near Kokstad, Feb. 1883, 1524m [Syn. B†]. *Schlechter 6548*, South Africa, Eastern Cape province, in rocky places near Umzimhlava, Jan. 1895, 1372m [Syn. B†].

Krebsia carinata Schltr., in Journ. Bot. 33: 269 [1895]. **Types**: As above.

Gomphocarpus carinatus (Schltr.) Schltr., in Journ. Bot. 42: 258 [1904]. **Type:** As above.

Xysmalobium carinatum (Schltr.) N.E. Br., in Fl. Cap. 4(1): 568 [1907]. **Type:** As above.

Discussion: Both N.E. Brown (1909) and Bullock (1956) are both correct that *S. carinatum* is similar to *S. periglossides* and *S. capense* repectively. In fact, *S. carinatum* is somewhat intermediate between these species and *S. involucratum*. Like *S. involucratum S. carinatum* has a barrel-shaped gynostegial-column, small, fleshy, tear-drop-shaped corona-lobes and angular anther-wings with the widest part in the middle and not at the bottom, and with a distinct notch along its length. Like *S. capense*, *S. corniculatum* and *S. periglossoides* this species has erect petals which form a campanulate corolla that completely hides the gynostegial-column. Apparently plants are found in damp grassy areas; similar to *S. periglossoides*. At altitudes of about 1371 to 1555 meters.

Distribution: South African endemic [Eastern Cape province only (in the region of Kokstad)] (fig. 24).

Conservation Status: Endangered. Known from no more than five specimens, over half of them collected almost a 100 years ago. Also extremely restricted in distribution.

Representative Specimens: South Africa: Eastern Cape: *Acocks 22007*, near Kokstad [PRE]; Coleman

5. *Stenostelma involucratum* (E. Mey.) Nicholas. *Comb. Nov.* **Types**: *Drège s.n.,(IV, B, c)*. South Africa, Eastern Cape province, between Welgelegen & Onzer at 2000ft (= 610m) [Syn. B†]; *Drège s.n., (V, b)*. South Africa, Eastern Cape province, near the mouth

of the Umzimkulu river [Syn. B†]; *Drège s.n. (I, a),* South Africa, Eastern Cape province, in the mountains at Katberg at 4000 to 5000ft (=1219 to 1524m.) [Syn. B†].

Lagarinthus involucratus E. Mey., in Comm. Pl. Afr. Austr.: 203 [1838] *pro parte.* **Types**: As above.

Gomphocarpus involucratus (E. Mey.) Dietr., in Syn. Pl. 2: 900 [1840]. **Types**: As above.

Xysmalobium involucratum (E. Mey.) Decne., in DC. Prodr. 8: 520 [1844]. **Types:** As above.

Saxymolbium involucratum (E. Mey.) Stewart & Langley, M.Sc. thesis: 70 [1980]. Name not effectively published.

Asclepias chloroglossa Schltr., in Journ. Bot. 1896: 454 [1896]. Replacement name for *Asclepias involucratum* which is already in use **Type**: As above.

Schizoglossum umbelluliferum Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 24 [1895]. **Type**: *Schlechter 3687,* South Africa, Gauteng, plain at the foot of the Magaliesberg, 1402 [Holo. B†]. Placed into synonomy here.

Discussion: Besides *Gomphocarpus fruticosus* and *Xysmalobium undulatum* (which are both somewhat weedy in nature), this is one of the most widespread and commonly encountered asclepiad in southern Africa. It would be interesting to establish why this diminutive species is so successful, especially as fruiting specimens are seldom encounted. Although widely distributed, this species is florally similar throughout, but vegetatively it can vary quite considerably; especially in habit, and leaf shape and size (fig. 26). Ecotypes are also relatively rare for a species with such a large geographical and topological range, although a fairly distinct form occurs along the northern Eastern Cape and southern KwaZulu-Natal coastal zone. These specimens have more flat topped, rather than globose, inflorescences which are laxly flowered and have pedicels of irregular lengths. Flowers of this form are also slightly smaller than in the more common type.

This ecotype intergrades on its distributional margin with the more common form, as a result, we have been unable to allocate it any rank or a name.

Schizoglossum umbelluliferum is only known from the type specimen and like N.E. Brown (1907) we have been unable to trace it. N.E. Brown thought it might be conspecific with *Schizoglossum orbiculare* or even *Schizoglossum crassipes*. However, the habit of this species with its short (100mm tall) spreading erect stems and narrowly linear leaves with revolute margins, very short spreading corolla, petals with margins recurved, and oblong-ligulate corona-lobes with obtuse apex and double keeled inner surface suggest that it is conspecific with *Stenostelma involucratum*. We have thus placed it into synonomy under this species here.

Vernacular names include *udambisa omkhulu* (Zulu) and *hongersnoodboosie* (Afrikaans). The Zulu use an infusion of the stem-tuber as a sprinkling charm against evil. The flowers give off a strong, but pleasant scent for most of the day. When in a confined situation this scent is powerful enough to induce headache. A variety of, usually medium small sized insects, have been noted visiting flowers, one of the exceptions to this being large Lyco beetles which can be quite common on the inflorescences, but it has not yet been established if these are pollinators. *S. involucratum* occurs in many different types of grassy habitats and on road reserves, usually growing in well drained soils. It is found to occur over a wide range of altitudes from sea level to the summit of the Drakensberg (ranging from 5 to 2150 meters) and flowers from September to February, peaking between October to December.

Distribution: Southern African endemic. Lesotho and South Africa [Gauteng, Mpumalanga, Free State, KwaZulu-Natal and Eastern Cape provinces] (fig. 25). This species is widely distributed in the eastern half of the subcontinent

Conservation Status: Not yet threatened or vulnerable, although now becoming more scarce in some areas.

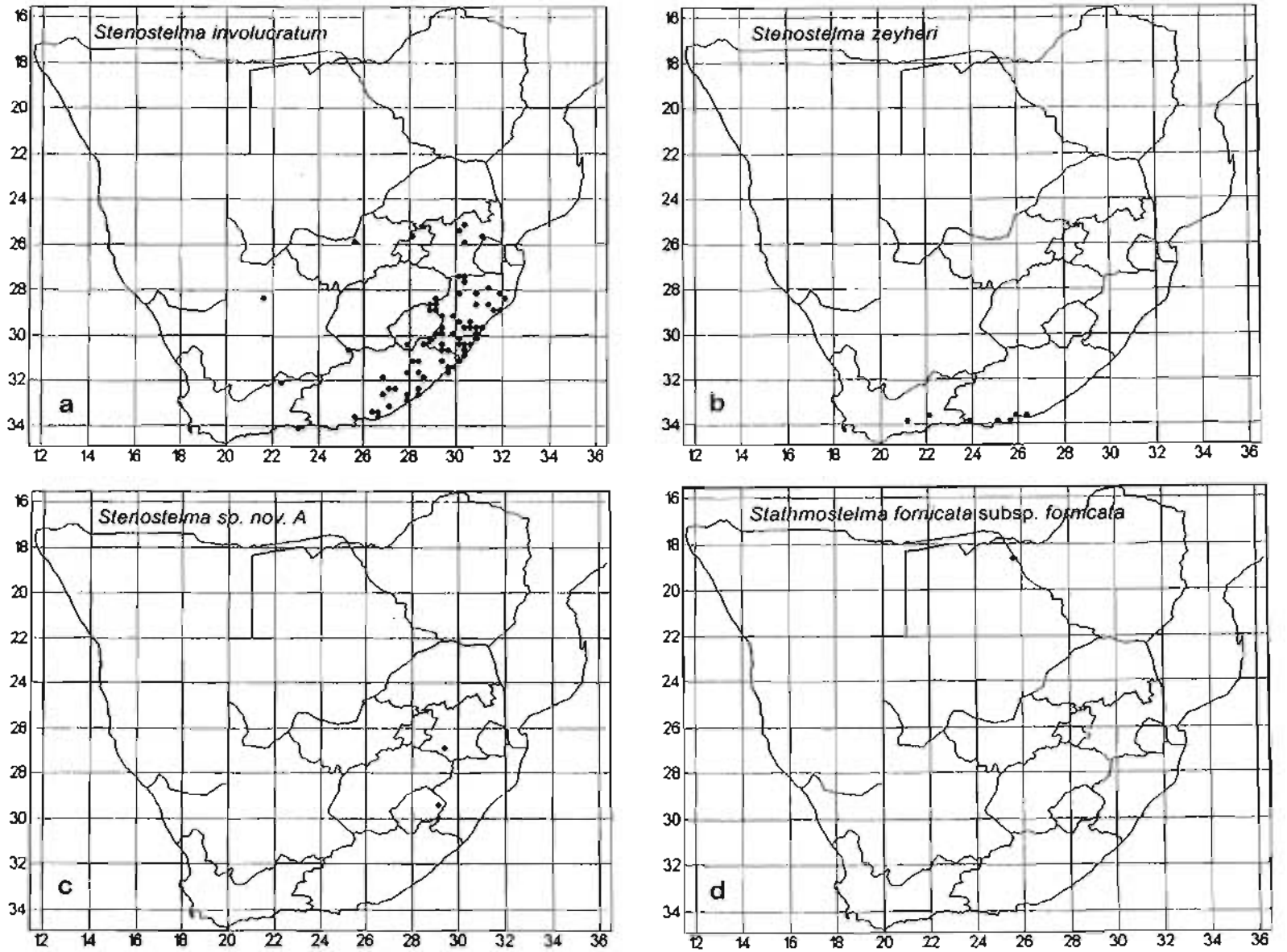

Figure 25. Distribution maps of: a. *Stenostelma involucratum*; b. *S. zeyheri*; c. *S. sp. nov. a* and; d. *Stathmostelma fornicata* subsp. *fornicata*.

Representative Specimens: Lesotho: *Dieterlen 491*, Leribe [NH with drawing]; *Coetzee 527*, Liseleng Valley [BLFU]; *Bayliss 7907*, near Ramas Gate [PRE]; *Jacot Guillarmod, Getliffe & Mzamane 137*, Sehlabathebe [GRA, PRE]. **South Africa:** Gauteng: *Goossen s.n.*, Pretoria [PRE]. Mpumalanga: *Galpin 13071*, Suikerboskop, Dullstroom [PRE]; *Smook 891*, Skoonwater farm, near Machadodorp [PRE]; *Codd 8303*, Kemps Heights, near Lydenburg [PRE]. Free State: *Puttrill s.n.*, Platberg, Harrismith [PRE]; Jacobsz 3510, Seheletwanberg [PRE]. KwaZulu-Natal: *Abbott 4678*, Ngele [NH, PRU]; *Venter 3493*, Ngoye Forest Reserve [PRE fruit]; *Nicholas 1001*, between Ixopo & Highflats [CPF]; *Nicholas 1014*, Blinkwater mountains, Karkloof [CPF]; *Nicholas 1164 with Norris*, Nkonzo State Forest [CPF, NH with stem-tuber]; *Nicholas 1197 with MacDevette*, Ngome State Forest [CPF, PRE]; *Nicholas 1154 with Norris*, Nkonzo State Forest [CPF, PRE]; *Nicholas 1677 with Marais*, Weza State Forest [CPF]; *Nicholas 1228*, Monks Cowl State Forest [CPF]; *Nicholas 2742 with Poorun*, Dukuduku State Forest [UDW]; *Nicholas 2761 with Poorun & Govender*, Kamberg [UDW]; *Venter 2751*, Ubisana Valley, Mtunzini [BLFU]; *Edwards 333*, Fort Nottingham Commonage [NU]; *Williams 1013*, Ngoye Forest Reserve [NH]; *Ward 14602*, Everton [UDW]; *Stirton 12272*, Banners Rest [NU]; *Strey 9347*, Ngome [NH]; *Greene 407*, Fort Nottingham Commonage [NH]; *Strey 7369*, Dukuduku [NH, PRE]; *Devenish 902*, Retirement farm, Utrecht [PRE]; *Langley 21*, Cathedral Peak Forest Reserve [NU with stem-tuber]; *Harriss 149*, Nauwhoek farm, Utrecht [NU]; *Ward 5237*, Merebank east, Durban [PRE with stem-tuber]; *Acocks 12938*, near Ntonjaneni [PRE]; *Dyer 3238*, Underberg [PRE with stem-tuber]; *Acocks & Hafstroom 1133*, between Port Shepston & Margate [PRE]; *Schlechter 1260*, Kranzkloof [PRE]; *Langley 21*, Cathedral Peak Forest Reserve [NU]; *Balkwill & Manning 440*, Umtumvuna Nature Reserve [NU]; *Hutton 44*, Shafton, Howick [GRA]. Eastern Cape: *Nicholas 2802 with DC Nicholas*, Happy Valley near Hogsback [UDW]; *Nicholas 2817 with DC Nicholas*, Martindale area near Grahamstown [UDW]; *Nicholas & Harrison 2374*, Mkambati Nature Reserve [PRE]; *Phillipson &*

Hutchings 61, Menziesberg [UFH]; *Dold 2219*, Kap River Reserve [GRA]; *Dold 2963 with Cloete & White*, [GRA]; *Cloete 2091*, Magwa Estate, Lusikisiki [NH]; *Bester 2071*, Cathgarva farm, Elliott [NH]; *Granger 3909*, Upsala farm, near Bertvale [PRE]; *Germishuizen 1451*, Faraway, near Grahamstown [PRE]; *Mogg 13058*, Ndhluzubu Head, near Port St Johns [PRE]; *Dyer 2410*, West Hill, Albany district [PRE]; *Tyson 1886*, Mt. Currie [PRE]; *Sim 2360*, King Williams Town [NU]; *Edwards 732a*, Nico Malan Pass [NU]; *Edwards, Cadman & Norris 3276*, Frazer's Falls [NU]; *Jacot Guillarmod 9295*, Faraway, Coldsprings [GRA]; *Dold 1330*, Woodcliffe farm, Joelshoek Valley, Maclear district [GRA]; *Dold 141*, Mahlasela Park Commonage [GRA]; *Bayliss 2523*, Fraser's Falls, near Bizana [GRA]; *Daly 585*, Trapp's Valley [GRA]; *Sole 421*, Katberg [GRA]; *Rattray 248*, East London [GRA]; *Schonland 93*, Fort Cunnynghame [GRA]; *Smart ex Rogers 28404*, Plettenberg Bay [GRA]; *Dyer 394*, near Ghulu Kop, Keiskamahoek [GRA]; *Zeyher & Ecklon 25*, Kowie [GRA]; *Flanagan 390*, near Komga [GRA]; *Galpin 1656*, mountains near Queenstown [GRA]; *Scully 123*, Lushington Mountain [GRA].

northern Eastern Cape/southern KwaZulu-Natal coastal ecotype: *Manning 282*, St-Michael-on-Sea [NU]; *Schonland 3940*, East gate, Port St. Johns [GRA]; *Balkwill & Manning 440*, Umtamvuna Nature Reserve [NU]; *Dold 2964 with Cloete & White*, Mount Thesiger, Port St Johns.

6 *Stenostelma zeyheri* (N.E. Br.) Nicholas. *Comb. Nov.* **Type**: *Drège s.n. (V, a),* South Africa, Eastern Cape province, in the Zuureberg, at Addo & near Geelhoutboom at 1000 to 2000ft (= 305 to 762m.) [Syn. *n.v.*]. Ecklon & Zeyher 348, Van Stadens Mountains, Uitenhage division [Syn. *n.v.*]

Xysmalobium zeyheri N.E. Br., in Fl. Cap. 4(1): 567 [1907]. **Type**: As above.

Lagarinthus involucratus E. Mey. Comm. Pl. Afr. Austr [1838] *pro parte.*

Discussion: This species is similar to *S. involucratum*, and was considered to be a synonym under it by Langley (1980). However, we have looked at material of this taxon and, along with N.E. Brown (1907), consider it to be distinct at the specific level. Estelle Brink doing routine identifications at the Schonland Herbarium in Grahamstown has also noticed the distinctness of this taxon (pers. com.). It differs from *S. involucratum* as follows: The inflorescences are laxly flowered (although this is also, albeit, rarely exhibited in some *S. involucratum*), the gynostegial-column is distinctly stipitate with the corona produced about 1.5mm above its base (in *S. involucratum* the gynostegial-column is sessile and not stalked, as a result the corona is produced at its base), the corona-lobes are not sessile but slightly stalked so that they stand slightly free from the anthers, the anther-wings are broadest near the base so that the notch along its length is about level with the middle of the corona-lobes (in *S. involucratum* this notch occurs above the corona-lobes). A case could possibly be made to include it as a subspecies of *S. involucratum*, but to us the differences are at once so apparent that we have chosen to maintain it at specific rank. *S. zeyheri* flowers between December and February and plants are found at alititude of between 300 to 600 meters.

Distribution: South Africa endemic [Eastern Cape & Western Cape provinces only] (fig. 25).

Conservation Status: Low Risk (Near Threatened). Of very limited distribution and rarely encountered. Also occurring in a heavily populated and over exploited area of South Africa.

Representative Specimens: South Africa: Eastern Cape: *van der Planki s.n.*, Kunene Park, Post Elizabeth area [GRA]; *Oliver 8809,* Garcias Pass [STE]; *Esterhuysen 21240 & 13631*, Die Hoek, Zsitsikama Mountains near Joubertina [PRE]. Western Cape: *Without collector & number*, Oudtshoorn [GRA].

7. *Stenostelma Sp. Nov. A*

Discussion: There are a number of specimens in the National Herbarium of South Africa (PRE) that have been wrongly placed in *Asclepias* or *Xysmalobium* that, on close examination, prove to be an as yet unnamed species of *Stenostelma*. This species has a habit similar to *S. capense*. These plants are much branched at the base, with up to 15 or more, spreading erect to decumbent stems, these bear short (8.5—27.0mm long, 1.5—3mm wide) linear leaves with tapering to hastate bases, pointed apex and entire margins. The flowers are small and gathered into 4- or more-flowered, pedunculate inflorescences. Inflorescences are shortly pedunculate, extra-axillary and produced laterally at the upper nodes (fig. 25). The corona-lobes are ligulate, being oblong in shape, with a featureless surface that is shallowly chaneled down the inner face, the apex is obtuse, reflexed slightly outwards and exceeds the style-apex for about $^1/_3$ of its length. These corona-lobes are only ¾ the length of the corolla and do not project from the flower. The remnants of an interstaminal corona can be seen alternating with the staminal corona, these take the form of small featureless projections. The corolla is cupulate, 4.8—6.5mm tall, with the petals revolute and spreading erect. The anther-wings are typical of *Stenostelma*, but with the notch above the middle of the anther-wings. We have not seen this in any other *Stenostelma* species, although a similar phenomenon can be seen in *Periglossum*. The gynostegial-column is barrel-shaped and the slightly conical style-apex has a mammalia-like gland above the corpusculum (as in *S. capense* and *S. corniculatum*) and does not exceed the anther-appendage. The pollinarium is also typical of *Stenostelma*, with the pollinia hemicircular at the base, narrowing in the upper $^1/_3$ towards the apically attached translator-arms which are once bent and connected together by a small ovoid corpusculum. The only character anomalous in *Stenostelma* is the large, ovoid, semi-inflated follicle which can have a smooth or sparsely echinate surface, these are held erect on a recurved (instead of straight) pedicel. This character might eventually suggest the placement of this species elsewhere, but with the data at our disposal we have opted to

Figure 26. *Stenostelma involucratum*: a. Whole plant showing habit & habitat (*circa* 100mm tall); b. & c. Close up of inflorescences & flowers. *Stenostelma sp. nov. a*: d. e. *Stenostelma sp. nov. b*. Photographs: a & c anonymous and; b T. de Waal.

place it in *Stenostelma*. In Lesotho this species is found in dry alpine veld and occurs at altitudes of about 2500 meters. It flowers between December and February.

Distribution: Southern African endemic. Lesotho and South Africa [Mpumalanga province] (fig. 25).

Conservation Status: Data Deficient.

Representative Specimens: Lesotho: *Dohse 289*, Makhotlong [PRE]; *Coetzee 551*, Makhotlong [PRE with flowers & fruit]. **South Africa:** Mpumalanga: *Visser 40,* Standerton [PRE].

8. *Stenostelma Sp. Nov. B*

Discussion: One specimen in PRE bears a *determinavit* label which reads "*Schizoglossum sp. affinis S. eustegioides* (E. Mey.) Druce. Not matched in Herb. Kew." This specimen belongs to a new species of *Stenostelma*. This specimen has stems that are solitary, unbranched, erect, with fairly long internodes (16—22mm), flexuose (i.e. gently zigzagged) especially in upper portion, 210—280mm tall and which bear linear leaves, these 14mm long at the base, 39—48mm long above stem base, 1.5—2.8mm wide, with the midrib prominent below, tapering at the base, acute at the apex with margin entire. Inflorescences are extra-axillary, lateral at the upper nodes, umbelliform, 5—7-flowered, peduncles 11—24mm long. Flowers small, 3.8—5.0mm tall, corolla cupulate and spreading erect (fig. 26). The corona is in one series (viz. staminal), the lobes are ovate, ±2.5mm tall, ±1.8mm wide, dorso-ventrally flattened, broadly rounded at the base into a very short stalk. The corona-lobe apex is rounded to subacute, hollow abaxially, thickened and protruding slightly adaxially, and about level with the style-apex. The anther-wings have a protruding notch just below the middle. The anther-appendages are more or less shortly stalked with the broadly ovate blade above this erect. The style-apex is shortly conical and bifid. The pollinarium (which is about 0.8mm long) is slightly

unusual for *Stenostelma*, the pollinia being cosh-shaped and pellucid at the apex where it attaches to athe long translator-arm which is broad at the base and narrows where it attaches to the ovoid corpusculum. Unfortunately, the only specimen we have seen (*Schoenfelder 23a*) has no label so we have little information on it inlcuding its locality.

Distribution: Unkown.

Conservation Status: Data Deficient.

Representative Specimen: Without Precise Locality: *Schoenfelder 23a* [PRE].

Excluded Southern African Names:

Krebsia Harv. = ***Stenostelma* Schltr.**

Krebsia carinata Schltr. = ***Stenostelma carinatum* (Schltr.) Bullock**

Krebsia corniculatum (E. Mey.) Schltr. = ***Stenostelma corniculatum* (E. Mey.) Bullock**

Krebsia stenoglossa (Schltr.) Schltr. = ***Stenostelma capense* (Schltr.) Nicholas**

Stenostelma eminens (Harv.) Bullock = ***Bruynsia eminens* Nicholas** in press

PERIGLOSSUM Decne., in DC. Prodr. 8: 520: [1844]. **Type species:** *Periglossum angustifolium* Decne.

Description: *Habit*: Perennial geophytic herbs; with milky latex. *Underground organ:* A small globose or napiform stem-tube, 22.5—70.0mm long, (7-)10—17mm wide. *Stems* usually 1, rarely as many as 4, unbranched, erect, 126—775(-1400)mm tall, internodes 38—90mm long, often glabrous below & unifariously to bifariously puberulous above or hairy throughout. *Leaves* 5—7 pairs per stem, opposite, sessile, paten, spreading-erect to erect, simple, entire; lamina linear to almost filiform, (26-)45—170mm long, 1.0—4.2mm wide, apex acute, margins revolute, adaxial & abaxial surface glabrous sometimes with midrib below puberulous. *Inflorescences* pedunculate, umbel-like, densely globose,

11—20mm in diameter, 1—5 per stem, laterally produced at the upper nodes & sometimes terminal, extra-axillary, 6—many-flowered; peduncles 12—64mm long, unifariously puberulous; bracts subulate to linear-subulate, 3.5—4.5mm long, slightly puberulous. *Flowers* yellowish brown, dark yellow, reddish brown or greenish, sometimes marked at the base with purple; pedicels very short (appearing sessile), 0.7—1.7mm long. *Calyx* 5-merous; lobes 3.0—4.5mm long, 1.5—2.2mm wide, apex acute, adaxial surface glabrous, abaxial surface sparsely puberulous, sometimes with hairs more or less tortuous. *Corolla* 5-merous, erect or slightly spreading, cup-like, divided more or less to base, without a corolline corona; lobes oblong-linear, oblong-lanceolate to oblong-ovate, 5.5—6.8mm long, 1.5—3.0mm wide, apex acute to subacute, margins smooth to revolute, sometimes slightly concave at the base & convex above with the tips straight, recurved or twisting in the upper $^1/_3$ to the left waxy & glabrous on both surfaces. *Staminal-corona* in 2-series sometimes appearing 1-seriate, arising at the base of the gynostegial-column. Outer-corona 5 merous; lobes erect, sometimes almost as long as the petals, shortly connate at their bases into a curtain, free part with a narrow to broad stalk, supporting a sagittate-ovate, oblong-linear to oblong-elliptic, 4.0—6.8mm long, 1.5—3.5mm long, blades (which sometime resemble petals) as long as the stalk or 2 to 2½ times longer than the stalk, apex obtuse, sometimes slightly reflexed, overtopping the style-apex, base sagittate, subcordate, truncate, rounded or tapering, inner surface with or without 2 apical longitudinal fleshy ridges, swollen or flat, smooth below or with a horizontal protrusing ridge of tissue with a shallow or deep cavity below, this cavity covered by two flaps of vertical tissue that overlap to form a channel below the covered cavit or horizontal protruding ridge absent & paddle-like flaps at the very stalk base, the protruding ridge of tissue level with & pressed into the hollow produced by the stalk of the anther-appendages. Inner-corona of 5 rudimentary, minute or filiform lobes, 1.5—4.o or these absent, if present then alternating with the outer corona-lobes. *Staminal-column* barrel-shaped to subglobose, constricted below & above, broadest in the middle, 2.8—

4mm tall. *Anthers* with a broad thin membranous connective, the anther-sacs firm, extended to the gynostegial-column base, slightly inflated & rounded on the abaxial surface; anther-wings long not horny except at the apex where they form small triangular projections tipped with a notch; anther-appendages stalked at the base so that the apical part is held above the style-apex, apical part broadly ovate to deltoid triangular, apex subacute, connivent, chaneled down the upper surface & stalked, white, membranous. *Pollinaria*: pollinia solitary & pendulous in each anther-sac, small, semicircular-curved or sausage-shaped, flat & translucent basely, terete & opaque apically where they are attached by long, sinuous or sigmoidly curved translator-arms that are at least twice as long as the pollinia; corpusculum minute. *Style-apex* small, flatish or knob-like, not exceeding the anthers, but sometimes produced beyond the corpuscula. *Follicles* solitary or paired, erect, narrowly fusiform, 50—90mm long, 5.5—7.0mm wide, smooth, with an apical beak; pedicel stout in fruit. *Etymology:* From the Greek *peri-* (= around) & *glossum* (= tongue), in reference to the tongue-like corolla & corona that surrounds the gynostegium.

Discussion: *Periglossum* is similar to *Cordylogyne* in its erect solitary tall unbranched stems, compact globose inflorescences and sedge-like appearance, and some authors (Bentham & Hooker, 1876; Eyles, 1916 & Liede, 1997) have even placed it into synonymy under *Cordylogyne*, but it is quite distinct. *Periglossum* differs from *Cordylogyne* in having the gynostegial-column barrel-shaped, not cylindrical. The remains of the inner corona-lobes are present as short filaments that alternate with the outer corona-lobes. *Periglossum* also has differently shaped and textured anthers and anther-appendages. The anther-appendages are held above the style-apex on stalked bases (in *Cordylogyne* they rest on the style-apex), the appendage at the top of this stalk is heart-shaped and spreads horizontally, together with the other appenadges these become connivent to form a suspended roof over the style-apex. The cavity formed by the stalked anther-appendage corresponds with the horizontal protruding ridge of tissue on the

corona-lobes of some species. The style-apex is knob-like, reminiscent of *Cordylogyne* but unlike this taxon it is hidden by the anther-appendages and is not clavate, elongated, and does not does not project high above them. The pollinarium structure in *Periglossum* is also quite different, with the pollinia subclavately, opaque at the end attached to the translator-arms, flattened and semitransparent at the truncated distal end. The translator-arms are fairly stout, sinuous, twice as long as the pollinia, swollen and slightly excavate where it attaches to the pollinium. The corpusculum is minute compared to the rest of the structure. N.E. Brown (1908) pointed out many of these feature and also the fact that in *Periglossum* the globose inflorescences are usually more numerous, and their peduncles and pedicels are much shorter. Also in *Cordylogyne* the stem-tuber is fleshy, narrowly cylindrical and deep-seated while, in *Periglossum*, they are carrot-like or shortly napiform. There are also habitat differences: *Cordylogyne* being found only in wetlands while *Periglossum* grows not only in wetlands, but also in drier situations. Given the number of differences, in particular the profoundness of some of these (such as the different androecial and gynoecial structure), we have decided to follow N.E. Brown in maintaining this genus as distinct. However, unlike N.E. Brown, we have reduced the number of species from four to three. *P. angustifolium* has a distinct corona-lobe shape (horseshoe crab-shaped), whereas *P. mackenii*, *P. kassnerianum* and *P. mossambicensis* have the same type of corona-lobe (shortly stalked and oblong above or resembling an ice-cream lolly on a short stout stick) and differ only in small details. Corona-lobe characters are geographically linked and the extremes of this morphological diversity seem to represent distinct entities, however, it is impossible to draw a line between these ecotypes as they all merge with each other and no clear discontinuity can be found. As a result, we have sunk them under the older name *P. mackenii*. To this genus we have also added a new species: *Periglossum podoptyches*.

Distribution: South African endemic. Botswana, Lesotho, Namibia, South Africa [North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal and Eastern Cape] and Swaziland. Also Zimbabwe and Mozambique.

Key To Species:

1a Corona-lobes divided into a long, narrow, linear stalk bearing a dilated sagittate-ovate blade of equal length. Inner corona-lobes filiform 1.5 to 4mm long ..... *P. angustifolium*

1b Corona-lobes with a short broad basal stalk bearing an oblong to elliptic-oblong blade 2 to 2½ times as long as the stalk. Inner-corona rudimentary to 2mm long 2

2a Corona-lobes with thickened transverse ridge of tissue on the inner surface below which there are folded flaps of tissue below (these not at the stalk base ..... *P. mackenii*

2b Corona-lobes with inner surface smooth (without a thickened transverse ridge of tissue), folded flaps of tissue at the stalk base ..... *P. podoptyches*

1. ***Periglossum podoptyches*** Nicholas. *Sp. Nov.* **Type:** *Ngwenya 1107,* South Africa, KwaZulu-Natal province, Dannhauser area, Fairbreeze farm, 26.12.1984 [Holo. NH. Iso. PRE].

Organa subterraneus *parvus, carnosus, cylindricus, ±62mm longus, ±10mm latus caulis tubere.* ***Caulis*** *unicus, erectus, non ramus, 172—230(-440)mm elatus.* ***Folio*** *lamina linearis ad filiform, 28—132mm longo, 0.7—2.5mm latus, principalis costa prominens.*

Inflorescentia *umbelliformis, erectus, globosus; pedunculus12—18(-35)mm.* ***Floribus*** *sessilis, tubularis, ±20 per inflorescentibus.* ***Corolla*** *tubularis, lobus oblongus ad lanceolatus, (5-)7—9mm longus, 2—2.5mm latus; viridi-flavus, margine revolutus.* ***Staminalis coronae*** *inaequalis, biseriatus. Lobus externus erectus, complanatus dorsaliventralis foliiformis, 4.8—5(-6)mm elatus, lamina ovatus, 3—4.5mm longus, 1.8—2.2mm latus, insuffultus 0.5—1(-2)mm longus, 0.7—1mm latus stipe, pagina intra eproprietas apicem convexus, stipe cum duo adpressus contextus appendices. Lobus intra rudimentum, filiformis-dentatis, 0.5—0.7mm longus, ±0.08mm latus* ***Staminalis-columna*** *subglobosus, ±3mm latus. Anthera-alarum parvus, apicalis, latus quam elatus, 0.3—0.4mm elatus, 0.7—0.9mm latus. Anthera-appendice sagittatus-ovatus, 1.5—1.8mm longus, 1.1—1.3mm latus.* ***Styli-apicem*** *truncatus.* ***Folliculi*** *solitarius, erectus, fusiformis, ±70mm longus, 5.5—6mm latus, laevis sed pubescens.*

Description: *Habit:* Perennial, geophytic herb; with mily latex. *Underground organ:* A small cylindrical swollen stem-tuber with white flesh, ±62mm long, ±10mm wide. *Stems:* Solitary, erect, terete, unbranched, 172—230(-440)mm tall, internodes 13—44mm, bottom leaves caducous, glabrous to bifariously hairy. *Leaves* opposite, simple, spreading-erect; lamina linear to almost filiform, 28—132mm long, 0.7—2.5mm wide, apex acute, base cuneate, margins smooth & revolute, only midrib very prominent below, glabrous; petiole sessile, subsessile up to 4mm. *Inflorescences*: Umbel-like, erect, globose, 16—17mm in diam., produced laterally at the nodes & terminally, extra-axillary, 1—3 from the same point, ±20-flowered; peduncles 12—18(-35)mm long; bracts filiform, 3.2—4.0mm long, 0.3—0.45mm long. *Flowers:* sessile, tubular, 6—7mm wide at the top. *Calyx* reaching to the corolla sinuses; lobes lanceolate to ovate, 4.5—6.0mm long, 1.2—2.0(-2.5)mm wide, adaxial surface glabrous, abaxial surface pubescent; small, lanceolate septal glands opposite sinuses. *Corolla* tubular, connate in basal 5th or almost free to the base; lobes erect, oblong, linear-oblong to lanceolate, (5-)7—9mm long, 2.0—2.5mm wide, apex with margins inflexed & connivent to form a small sharp point,

margins revolute & wavy in upper part, glabrous. *Staminal-corona:* in 2 unequal series, produced at the gynostegial-coulmn base. Outer-corona 5-merous, fused basally; lobes, erect, dorso-ventrally flattened, leaf-like, 4.8—5.0(-6.0)mm long, consisting of an ovate blade 3.0—4.5mm long, 1.8—2.2mm wide supported on a short neck 0.5—1.0(-2.0)mm long, 0.7—1.0mm wide, inner face smooth, apical portion convex with 2 obscure longitudinal ridges margins revolute (as if pinched) & concave on outer surface, apex obtuse to slightly emarginate, basally tapering into a short stalk which has two laterally placed, paddle-shaped or foot-shaped, irregularly margined, inflexed & appressed flaps of tissue, margins sometimes slightly reflexed below, much reflexed apically, outer surface smooth & featureless. Inner-corona 5-merous; lobes short, dentate-filiform, 0.5—0.7mm long, ±0.08mm wide. *Staminal-column*: subglobose with anther-wings & anther-appendages forming a frilly cap over the style-apex, ±3mm wide; stamens 2.5—4.0mm long, 1.5—1.8mm wide; anther-wings small produced at the very apex of the anthers (above the anther-sacs), spreading horizontally, 0.3—0.4mm long, 0.7—0.9mm wide, gynostegial-groove wide 0.4—0.5mm & gutter-like; anther-appendages sagittate-ovate, folded basally & connivent at the acute apex, 1.5—1.8mm long, 1.1—1.3mm wide, held well above the style-apex on short basal stalks. *Pollinaria*: Pollinia solitary & penduolus in each anther-sac, oblong-curved or bomerang-shaped, 1.0—1.2mm long, 0.25—0.3mm wide, attached apically to the translators; translator-arms long, thin, sinuous, 1.3—1.5mm long, 0.03mm wide at the top, 0.05mm wide & excavated at the base where it attached to the pollinia; corpusculum diamond-shaped, 0.2—0.3mm long, ±0.2mm wide, with 2 downwardly pointing paddle-like wings ±0.02mm long, ±0.08mm wide. *Style-apex:* small & truncated. *Follicles:* Solitary, erect, narrowly fusiform, ±70mm long, 5.5—6.0mm wide, apex attenuately beaked & slightly curved, surface smooth, tomentose when young, sparsely hairy when mature. *Etymology:* From the Greek *podion* (= foot) and *ptyches* (= folds). In reference to the foot-like folds of tissue at the corona-lobe base.

Discussion: This species has an ovate or oblong corona-lobe similar to *P. mackenii*, however, unlike that species the adaxial or inner surface is featureless (without a protruding fleshy horizontal ridge of tissue), although the apex may be slightly swollen. In *P. mackenii* two fold of tissue can be found below this protruding ridge, in *P. podoptyches* they occur at the base of the corona-lobe stalk. These flap-like folds of tissue a foot-shaped (narrower at the base, broader at the apex which is gently crenulate). The corona-lobe blade bottom is not rounded, truncate or saggitate, but tappers into the short basal stalk (fig. 29). Because of its simple corona-lobe structure this species is somewhat like Stenostelma, as a result, we have placed it first in our series. *P. podoptyches* is found in dry grasslands, and flowers in December.

Distribution: South African endemic [KwaZulu-Natal province (Dannhauser & Utrecht districts)] (fig. 28).

Conservation status: Vunerable. So far only known from two localities in a fairly well collected province. We has classified it as vulnerable although it may even be considered endangered.

Representative Specimens: South Africa: KwaZulu-Natal: *Ngwenya 471,* Dannhauser district, Fairbreeze farm [NH]; *Wahl 15385*, Utrecht [PRE].

2. ***Periglossum mackenii*** Harv., Thes. Cap. 2: 7 & t.111 [1864]. **Type:** *McKen 664,* South Africa, KwaZulu-Natal, near Durban [Holo. TCD. Iso. NH].

Periglossum kassnerianum Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 40 [1895]. **Type:** *Schlechter 4043,* South Africa, Mpumalanga province, Olifants River. 22nd Dec. 1893, 1524m [Lecto. NH. Isolectos. GRA, MEL *fide* Forster (1994), PRE two specimens]. Reduced to synonomy here.

Cordylogyne kassnerianum (Schltr.) Eyles, in Trans. Roy. Soc. S. Afr. 5: 448 [1916]. **Type:** As for *Periglossum kassnerianum*

Periglossum mossambicense Schltr., in Bot. Jahrb. 38: 33 & t.2 [1905]. **Type:** *Schlechter 12284,* Mozambique, 25 miles inland from Beira, altitude about 70m, April 1898 [*n.v.*]. Reduced to synonomy here.

Cordylogyne mossambicense (Schltr.) Eyles, in Trans. Roy. Soc. S. Afr. 5: 448 [1916]. **Type:** As for *Periglossum mossambicense*

Discussion: Unlike the corona-lobes of *P. angustifolium*, in this species this structure consists of a short broad stalk, that supports a tongue-like oblong or oblong-elliptic blade that is 2 to 2½ times longer than the stalk. Also the inner corona-lobes vary from being minute and rudimentary to 2mm long. Although the corona-lobe is a fairly simple structure the surface ornamentation can be fascinatingly complex (fig. 29). Fairly distinct forms of corona-lobe ornamentation can be seen which corrolate with geography; these forms are discussed below. These have in the past been allocated names: *P. mackenii* in KwaZulu-Natal, *P. kassnerianum* in what was the old Transvaal and *P. mossambicense* in areas outside of South Africa. However all these forms intergrade with each other and no clear discontinuity can be found. As a result, we have been unable to uphold these species as distinct.

Form 1: Along the southern Natal coast and adjacent areas in the Eastern Cape the corona-lobe is 4 to 5mm long and ±1.7mm wide, with the short stalk sometimes barely distinguishable from the blade. The blade is oblong to elliptic-oblong in shape and about as twice as long as the stalk and tapering or subtruncate into it, the apex of the blade is thickened an obtuse, the inner surface is smooth and featureless except for a transverse, sometimes pointed ridge, in the middle (fig. 29). This form is the same as the type.

Form 2: In an arch outside of South Africa stretching from Mozambique through Zimbabwe and Botswana to Namibia the corona-lobes are 4.5 to 5.0mm long and ±1.7mm wide, shortly but noticeably stalked, the blade is lanceolate-oblong and 2½ times as long as the stalk, the apex is obtuse and the base rounded into the stalk, the inner face

Figure 27. *Periglossum mackenii*: a. & d. Portion of flowering stem; b. Inflorescences and; c. Close up of flowers. Photographs: a to c by A. Nicholas and; d by M. von Fintel.

is smooth and featureless except for a small transverse ridge or tubercle at about the middle (fig. 29). This form was in the past called *P. mossambicense* and is extremely close to *P. mackenii* especially along the coastal margin of Mozambique and Zululand.

Form 3: In the South African interior the corona-lobes are 4.5 to 5.0mm long and ±2mm wide, and always distinctly stalked, the blade is oblong to ovate-oblong and 2½ times as long as the stalk, the apex is obtuse, the base where it joins the stalk is cordate to cordate-sagittate, the upper portion of the inner face is thickened and bears two fleshy longitudinal keels which ends at the middle of the lobe where it joins with a transverse protruding horizonatl ridge of tissue, below this ridge is a cavity that is enclosed by two flaps of tissue that are contiguous and which form a longitudinal ridges that run down the stalk (fig. 29). This form received the name *P. kassnerianum*. Form 2 and 3 combine in Zimbabwe, Botswana and Namibia, sometimes also in Mozambique where they are difficult to allocate to either form.

This species (fig. 27) occurs in dry grasslands usually sourveld (with *Themeda*, *Eragrostis* or *Sporobolus*), grassy open spaces in woodlands or in damp situations such as sedge-meadows, vleis, flood plains, the edge of pans, along rocky stream banks, near *Miscanthidium* swamp or in marshy places. Plants are usually rare (many collectors report seeing only one specimen), less frequently said to be common. Plants flower from October to March, peaking in December, and are found at altitudes of ranging from 3 to 1500 meters. N.E. Brown (1907) quite correctly points out that the figure given in Harvey (1863) has the corona-lobes inaccurately illustrated.

Distribution: South & south central African endemic. In southern Africa found in Botswana, Lesotho, Namibia, South African [Northern, North West, Gauteng, Free State, Mpumalanga, KwaZulu-Natal & Eastern Cape (where it borders KwaZulu-Natal)] and Swaziland (fig. 28).

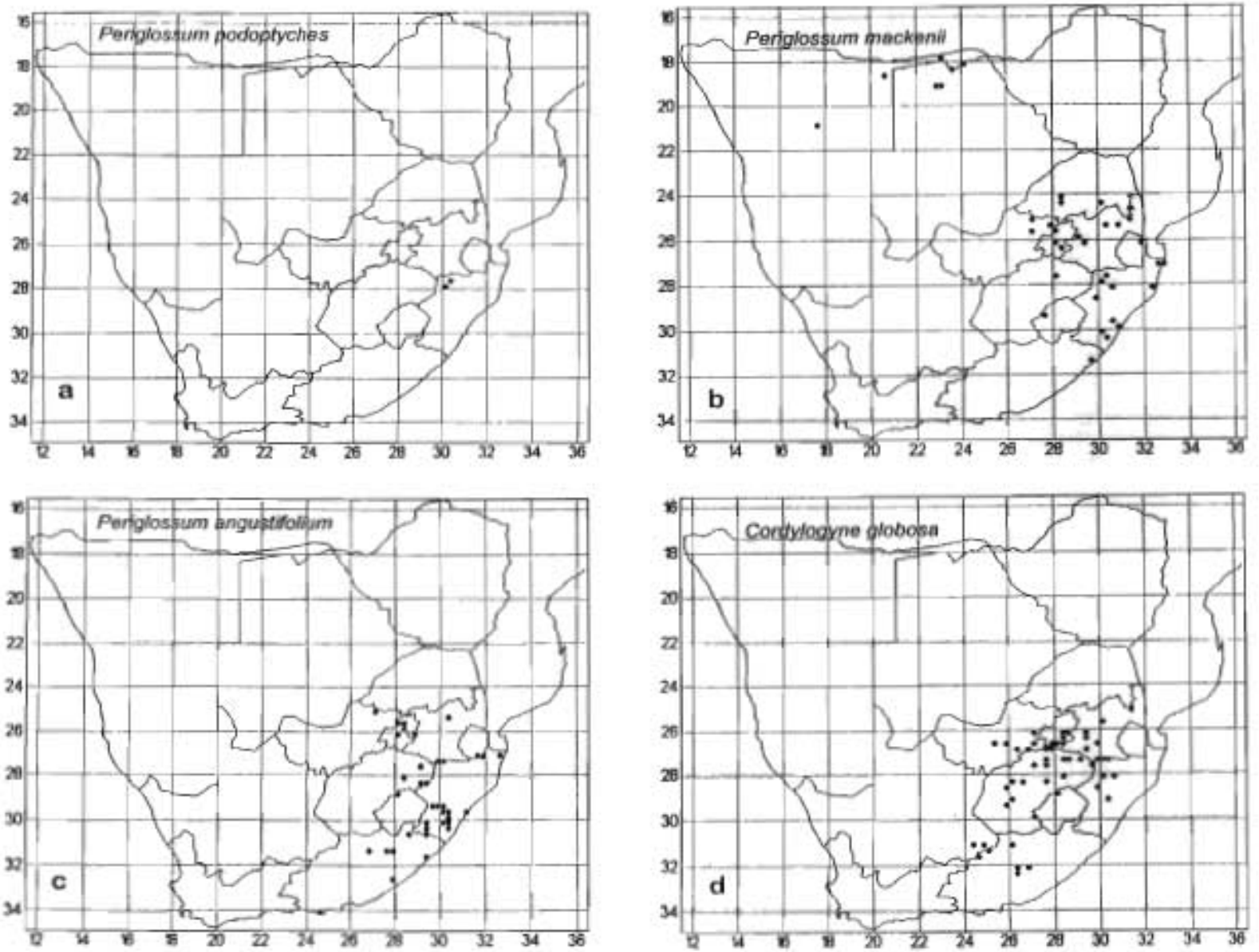

Figure 28. Distribution maps of: a. *Periglossum podoptyches*; b. *P. mackenii*; c. *P. angustifolium* and; d. *Cordylogyne globosa*.

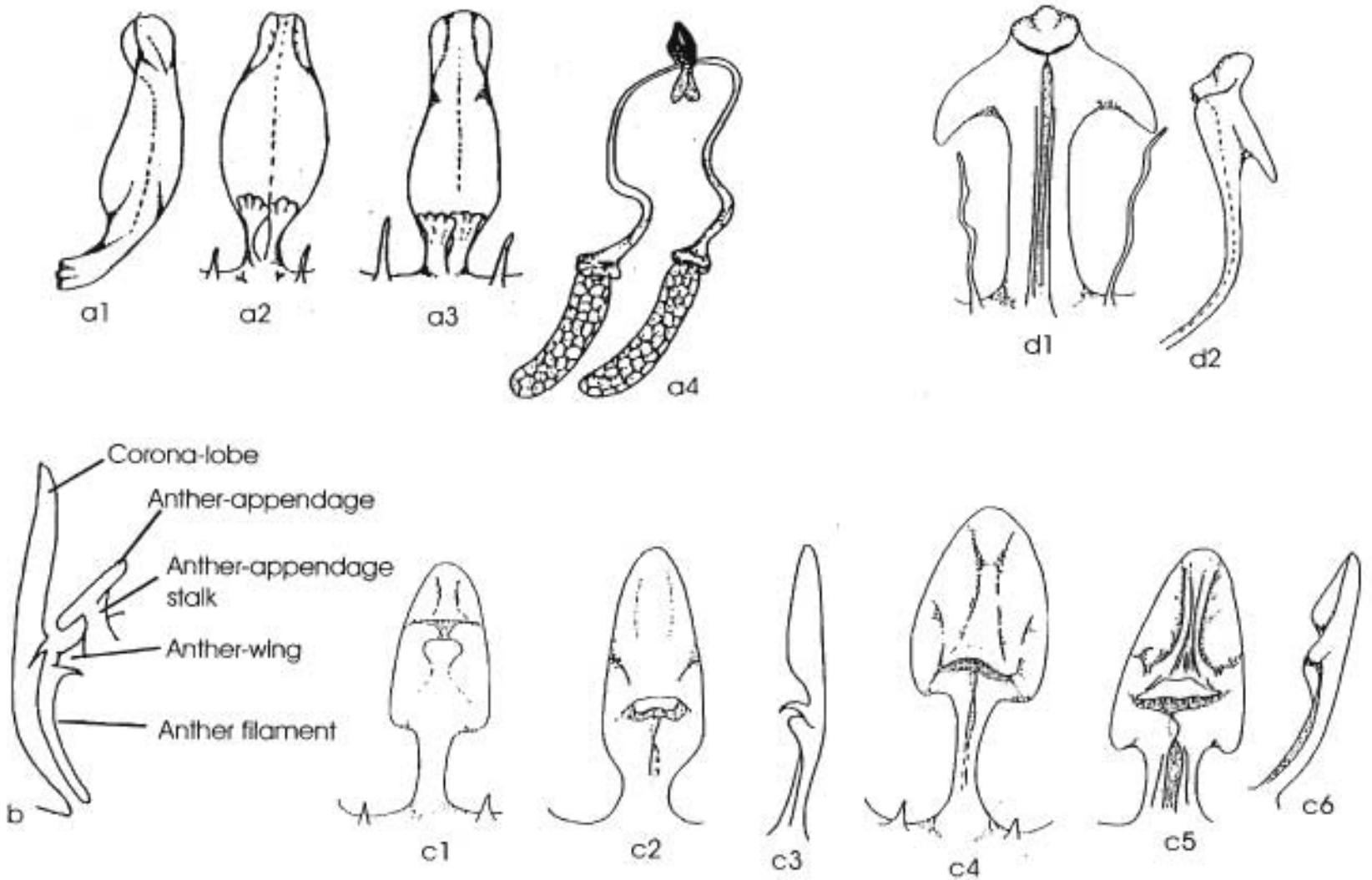

Figure 29. *Periglossum podoptyches*: a1. Corona-lobe side view x20; a2 & a3. Corona-lobe adaxial or inner surface x20, and; a4. Pollinarium x500. *P. mackenii*: b. Showing relationship of corona to gynostegial-column; c. Showing corona-lobe variation (note the short interstaminal or inner corona -lobes or these absent). c1 x13 & c2 x15. Form 1 (typical *mackenii*); c4 x15. Form 2 (what was typical *mossambicensis*) and; c5 x17. Form 3 (what was typical *kassnerianum*). c3 x15 & c6 x17. Side view of c2 & c5 respectively. *P. angustifolium*: d1 x 14. Corona-lobe inner surface (note the long interstaminal corona-lobes) &; d2 x14. Corona-lobe side view. a1 & a2 from Ngwenya 471 [NH]; a3 & a4 from Ngwenya 1107 [NH]; b & c4 from Liebenberg 2833 [PRE]; c2 & c3 from Germishuizen 3150 [PRE]; c1 from Thorncroft 690 [PRE]; c5 & c6 from Pegler 1022 [PRE] and; d1 & d2 from von Fintel 382 [NH]. Drawings by A. Nicholas.

Conservation status: Will probably become at risk in the next few decades. Vulnerbale in many areas, probably extinct in the Durban area where it was common at the turn of the century.

Representative Specimens: Botswana: *Smith 3012*, island at the Mboroga river headwaters [PRE with stem-tuber]. **Lesotho:** *Dieterlen 1015*, Botsabelo, near Maseru [PRE?]. **Namibia:** *Strey 2662*, Khaudum, Omusamba [PRE]; *Vahrmeijer 2178*, Linyanti, near Lake Lehambezi [PRE]; *Curson 1247& 1251*, Cuando river, Caprivi strip [PRE]; *Curson 88 & 89*, Mantswana [PRE with drawing]. **South Africa:** Northern: *van der Merwe 2341*, near Vaalwater, Waterberg [PRE with stem tuber]; *Breyer 17805*, Geelhoutkop [PRE]. North West: *Germishuizen & Retief 547*, Buffelskloof farm, Pilansberg district [PRE]; *Acocks 21951*, near Rustenburg [PRE]. Gauteng: *Pegler 1022*, Rustenberg [GRA, NH]; *Theiler 14820*, Wonderboom [PRE]; *Janse 2815*, Engelsche Doornboom [PRE]; *Smith 1557 & 1548*, Koedoespoort [PRE]; *Mogg s.n.*, Edendale [PRE 51666 with stem tuber]; *Elbrecht 15971*, Pretoria [PRE flowers & fruit]; *Burtt Davy 9165*, Uitgevallen, Heidelburg [PRE]. Free State: *Crosby 506*, Modus Vivendi farm, near Petrus Steyn [PRE]. Mpumalanga: *Codd 5738*, Pretorius Kop, Kruger National Park [PRE]; *Liebenberg 3282 & 2833*, Schagen, Nelspruit [PRE both with stem tuber]; *Bruce 83*, Vaalkrans, Witbank district [PRE]; *Bredenkamp 1713*, Manyeleti Game Reserve, Hermitage [PRE]; *Thode A2834*, Zondagsfontein [PRE]. KwaZulu-Natal: *Frank*, Camperdown [NH 12251]; *Nicholas 1003*, Umkomaas river valley, 20kms from Ixopo [MO, NH]; *Nicholas 977*, Near Ladysmith on road to Colenso [NH]; *Wood 7377*, near Durban [PRE]; *Ward 1830*, Manzengwenya plantation [PRE flowers, fruits & stem-tuber]; *Rudatis 2188*, Campbelton, Dumisa [PRE]; *Stephen, Graan & Schwabe 1189*, Vasi Swamp [PRE]; *Moll 4786*, Mansengwenya [PRE]; *Ward 2913*, near Charter's Creek [PRE with stem-tuber]; *Reid 1043*, Muzi swamp [PRE]; *Germishuizen 3150*, near Phelendaba turnoff on Mbaswane road [PRE with stem-tuber]. Eastern Cape: *Wager s.n.*,

Port St. Port [PRE 51502]. **Swaziland:** *Culverwell 1359*, Umbuluzi Nature Reserve [PRE]. Without Precise Locality: *Pegler 1010* [PRE].

Mozambique: *Noel s.n.,* Inhaca island [RU 10,941]; *Faulkner 145*, Namagoa [PRE]; *Boile 81*, Lorenzo Marques (= Maputo) [PRE]. **Zimbabwe:** *Drummond 4922*, Salisbury (= Harare) [PRE]; *Wilde 9065*, Zambezi river [PRE]; *Miller 3916*, Besua farm, Kopila, Matobo district [PRE].

3. ***Periglossum angustifolium*** Decne., in DC. Prodr. 8: 520 [1844]. **Type:** Untraced. Apparently in P.

Cordylogyne argillicola Dinter, in Fedde. Repert. 15: 242 [1919]. **Type:** Not traced.

Cordylogyne globosa sensu Meisn., in Journ. Bot. 2: 546 [1843], *et sensu* Krauss Flora: 827 [1844]. *non* E. Mey., Comm. Pl. Afr. Austr.: 218 [1838].

Discussion: Although vegetatively similar to *P. mackenii* the corona-lobes, being horseshoe crab-shaped, are, however, extremely distinctive. These corona-lobes are divided into a long narrow linear stalk which supports a dilated sagittate-ovate head; both parts being of about equal length. The top of the blade has a large horizontally oval protruding ridge of tissue that fits into the cavity formed by the anther-appendage stalk. Below this protrusion is a cavity enclosed by two opposing flaps of contiguous tissue that form a channel that run down the lenght of the stalk. The legs of pollinating insects are guided by the shallow channel on back of the horizontally placed and gentlely sloping anther-appendages towards the cavity on the corona-lobe. The protruding ridge and sagittate base on the corona-lobe blade prevents the leg from being drawn upwards. To get free the legs has to be dragged down the channel on the stalk, when it reaches the bottom it is now placed at the base of the anther-wings ready for pollinarium extraction. Also, the inner-corona lobes, which alternates with the outer corona-lobes, are filiform

and 1.5 to 4mm long (fig. 29). This species is found in midlands grassveld, often in moist ground or seepage areas. Plants flower from December to March, peaking January—February, and occurs at a very wide range of altitudes from between 30 to 2000 meters.

Distribution: Southern African endemic. Lesotho, South Africa [North West, Gauteng, Free State, Mpumalanga, KwaZulu-Natal & Eastern Cape province] and Swaziland (fig. 28).

Conservation status: Low Risk [Least Concern]. Endangered in many areas, possibly extinct in Gauteng.

Representative Specimens: Lesotho: *Dieterlen 491a*, Leribe [NH, PRE two specimens one with stem-tuber & one with fruit] **South Africa:** Gauteng: *Hutton 300*, Johannesburg [GRA]; *Verdoorn 1914*, Donkerhoek [PRE]. Mpumalanga: *Burgoyne 930*, Vermont Station [PRE]. Free State: *Retief 1932*, Langverway farm, near Vrede [PRE]; *Scheepers 1393*, near Bethlehem [PRE]; *Jacobsz 554*, Manyenyeza [PRE]. KwaZulu-Natal: Nicholas 2718 with Poorun, between Fort Nottingham & Mpendle [UDW with stem-tuber]; *Gordon-Gray 4570*, Nottingham Road [NU]; *Edwards 520*, Wahroonga, Merrivale [NU]; *Wood 4577*, Lynedock [NH]; *Moll 3464*, Ehlatini farm, Karkloof area [NH, PRE]; *Browning 911*, Wakkerstroom [NU]; *Schlechter 3070*, Congella Durban [GRA, PRE]; *Wood 5548*, Charlestown [PRE]; *Thode 1759*, Kenterton [STE with stem-tuber]; *Reid 883*, World's View, Pietermaritzburg [PRE]; *Immelman 257*, Michael House, Balgowan [PRE]; *Schlechter 1786*, Ixopo [PRE]; *Killick & Vahrmeijer 3674*, Upper Umkomaas, Impendhle district [PRE]; *Bruce 157*, near Cedar [PRE]; *Acocks 13448*, near Richmond [PRE]; *Pienaar 550*, Elandskop, Boston area [PRE]; *Hilliard & Burtt 7594*, Mawahgue Mountain [NU]. Eastern Cape: *Bowker 823*, Illetooli stream, Tsomo [GRA]; *Flanagan 590*, Komga [GRA, PRE]; *Flanagan 2621*, near Slangrivier [PRE]; *Bolus 10184*, Jackal's Kop, between Elliot & Maclear [PRE]; *Acocks 21988*, near Mount Fletcher [PRE with stem-tuber]; *Acocks 22050*, near Kokstad [PRE]; *Tyson 1360*, near Kokstad [PRE].

Excluded Names:

Periglossum macrum Decne. = ***Sisyranthus macer*** (E. Mey.) Schltr.

CORDYLOGYNE E. Mey., Comm. Pl. Afr. Austr.: 218 [1838]. **Type species:** *Cordylogyne globosa* E. Mey.

Cordylogne Lindl., Veg. Kingd.: 626 [1848].

Description: *Habit:* Perennial, geophytic herb; with milky latex. *Underground organ:* A very deep-seated narrow fleshy cylindrical stem-tuber. *Stems* usually 1, rarely as many as 15, usually unbranched, but if branched then at the base, erect, 120—765mm tall, lower internodes shorter than upper nodes which are 32—82mm long, glabrous below, puberulous on one side near the apex. *Leaves* opposite, sessile, spreading to spreading-erect, simple, entire; lamina linear to almost filiform, 25—90mm long, 0.7—3.5mm wide, apex acute, base cuneate, margins entire & revolute, both surfaces glabrous. *Inflorescences* pedunculate, erect or spreading-erect, umbel-like, globose, usually solitary & terminal, sometimes 2 or rarely up to 4 per stem then lateral at the upper nodes & terminal, 10—25-flowered; peduncles 25—254mm long. *Flowers* pedicellate, grayish-white, yellow, yellowish-brown or brown. *Calyx* 5-merous, suberect; lobes lanceolate to oblong, 2.0—3.4mm long, 1.2mm wide, apex acute, adaxial surface glabrous, abaxial surface puberulous. *Corolla* cup-like or campanulate, erect, 5-merous, divided to the base, without a corolline corona; lobes oblong, 4.5—5.6mm long, 1.6—2mm wide, apex obtuse & recurved for most of its length, puberulous. *Staminal-corona* in 1-series, arising at the gynostegial-column base, 5-merous; lobes free, erect, subspathulate-hastate to linear-oblong, 2.2mm long, 1mm wide at the apex, both lateral margins with triangular

ear-like projections at about the middle, apex obtuse & about level with the top of the anthers, inner surface with 2 longitudinal contiguous subfleshy keels in the lower half, capped by a transverse ridge-like or triangular-flap of tissue above the middle, outer surface flat & featureless. *Staminal-column* cylindrical, 2.0—2.8mm tall. *Anthers* with a broad, thinly membranous connective, anther-sacs extended to the anther base, these not inflated or curved outwards; anther-wings small, triangular with pointed tip & only produced at the very top of the anther margin; anther-appendages ovate to oblong, apex very obtuse, concave-erect at the style-column base, white & membranous. *Pollinaria:* Pollinium solitary & pendulous in each anther-sac, flattened, linear-oblong & only very slightly curved inwards, thinner, semitranslucent & tapering at the apex to where it attaches to the thin short (but shouldered in the middle) translator-arms that are shorter than the pollinia; corpusculum minute. *Style-apex* clavate or club-shaped, projecting 1.0—1.7mm above the anthers. *Follicles* solitary, erect, narrowly fusiform, ±75mm long, ±6mm wide, equally tapered at both ends, featureless but puberulously hairy; fruiting pedicel straight. *Seeds* bifacial, dorso-ventrally flattened, ovate, ±6mm long, ±3mm wide, with broad margins, minutely papillate-rugulose on both sides, light brown. *Etymology:* Named from the Greek *kordyle* (= a club) and *gyne* (= female) in reference to the club-like style-apex which terminates the gynoecium or female whorl.

Discussion: This is a monospecific genus. The most distinguishing feature being the club-shaped style-apex that projects well above the anthers. Like *Periglossum* it is also unique in having a sedge-like stems & fairly simple corona-lobes. The differences between these genera are discussed under *Periglossum*. Found in damp grasslands or marshy places and, therefore, not usually subjected to annual veld fires.

Distribution: Southern African endemic. Lesotho and South Africa [North West, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape & Northern Cape provinces].

1. ***Cordylogyne globosa*** E. Mey., Comm. Pl. Afr. Austr.: 218 [1838]. **Type:** *Drége s.n. (I, a),* South Africa, Eastern Cape province, near Los Tafelberg & Wildschutsberg. 4000 to 4500ft (= 1220 to 1372m) [Isosyn. PRE 11778]; *Drége s.n. (I, b),* South Africa, Eastern Cape province, Slangerfontein, alt. 4600ft (= 1402m) [Iso. *n.v.*]; *Drége s.n., (I, d)* South Africa, Eastern Cape province, Steelkloof, alt. 3500ft (= 1067m) [Iso. *n.v.*].

Discussion: Plants occur in damp soil, marshy areas, wetlands and flood plains often within usually arid areas such as false Karroo. They are often said, by collectors, to be rare. This species flowers from October to March, peaking between November & February, and is found at altitudes of about 1000 to 2000 meters. Illustrated in de Candolle and de Lessert (1846).

Distribution: As for the genus (fig. 28).

Conservation Status: Wetlands are amongst the most threatened habitats in southern Africa, which does not bode well for the future of this species. Vulnerable to threatened in many areas. This species will probably be at risk within the next century.

Representative Specimens: Lesotho: *Dieterlen 1328*, near Bamohapin's Village, Meafeteng district [PRE]; Dieterlen 492, Leribe [PRE very short 120mm, with small leaves & flowers]. **South Africa:** North West: *Leendertzz 7992*, Potchefstroom [PRE]; *Louw 1175*, Rietfontein [PRE]; *Germishuizen 1048*, Taljaardt farm, Delareyville [PRE]; *Theron 1166*, Klipdrift [PRE]; *Ubbink 1320*, Mooiriver Bridge [PRE]; *Hanekom 2190*, Wolwerand, near Klerksdorp [PRE with stem-tuber]. Gauteng: *Gilfillan 7107*, Groot Vlei farm, Heidelberg district [GRA]; *Gilfillan 224*, Grootvlei farm, Heidelberg [PRE flowers & fruit]; *Breÿer 15018*, Boksburg [PRE]; *Bradfield 7304*, Benoni [PRE]; *Burtt Davy 5049*, Leeuwkuil, Vereeniging [PRE]; *Gilliland 26801*, Lower Klip river [PRE]; *Acocks 20829*, Kalkspruit flats [PRE]; *Burtt Davy 9140*, Uitgevallen [PRE]; *Schlechter 4015*, near Bergendal [GRA, PRE two specimens]. Mpumalanga: *Bottomley s.n.*, Belfast [PRE]; *Scholars 164*, near Ermelo [PRE]; *Pott 14924*, Spitskop [PRE]; *Leendertzz 9380*, Bethal

[PRE]; *Devenish 1498*, Rustfontein [PRE with stem-tuber]; *du Toit 8*, near Komati Power Station [PRE]; *Visser 63*, near Standerton [PRE]; *Codd 4714*, near Ermelo [PRE]; *Beeton 182*, Wakkerstroom [PRE]. Free State: *Potts 3582*, Bethal [GRA]; *Moraile s.n.*, Victoria Park, Bloemfontein [BLFU]; *Potts 1392*, near Lambon's Plantation [BLFU]; *Coetzee 784*, Middlekop farm, Vrede [BLFU]; *Smook 6560*, Arahamshof farm, near Theunissen [PRE]; *Scheepers 1770*, Vadersgift farm, Bethlehem [PRE]; *van Rensburg 152*, Lusthof farm, Edenville [PRE]; *Potts 1244*, Poundisford [BLFU]; *Scheepers 1322*, near Kroonstad [PRE]; *Acocks 14017*, near Dealesville [PRE]; *Herman 244*, near Bultfontein [PRE]; *Retief 1072*, Rietfontein farm, near Frankfort [PRE]; *Blom 315*, Seekoeivlei Nature Reserve [PRE]; *Scheepers 1692*, Geluk farm, near Kroonstad [PRE]; *Kroon 11446*, Sasolburg, Wonderwater [PRE]. KwaZulu-Natal: *Wood 4797*, near Charlestown [NH with drawing, PRE]; *Schlechter 3365*, Colenso [GRA, PRE]; *Johnstone 253*, Hattingspruit [NH, NU]; *Codd 8960*, Vantsdrift [PRE]; *Shirley s.n.*, Dundee [NU]; *Browning 872*, Slangrivier, near Groenvlei [NU]; *Thode A777*, Tweekloof (Altemooi) [NH, PRE]; *Fry sub Galpin 2738*, Greenwich farm, Riet Vlei [PRE]. Eastern Cape: *Bolus 2364*, near Dassiesfontein, Sneeuberg Mountains [GRA]. *Southey 5874,* Culmstock [GRA]; *Acocks 22062*, Guildford, Matatiele district [PRE]; *Acocks 17856*, Leeufontein, Middleberg district [PRE]; *Acocks 17956*, near Tarkastad [PRE]; *Acocks 16246*, near Wildfontein station [PRE]; *Acocoks 21862*, near Rosmead [PRE with fruit]; *Hanekom 1966*, Roelfsfontein, Richmond [PRE]; *Southey sub Galpin 5874*, Culmstock [GRA, PRE]; *Bolus 2364*, near Dassiesfontein [GRA]. Northern Cape: Sim 2862, Hanover [GRA]; *Sim sub Galpin 5998*, Hanover [PRE].

Excluded names:

Cordylogyne Lindl. = ***Cordylogyne*** E. Mey.

Cordylogyne argillicola = Application of name unresolved

Cordylogyne globosa sensu Meisn. = ***Periglossum angustifolium* (Meisn.) Decne.**

Cordylogyne kassnerianum (Schltr.) Eyles = ***Periglossum kassnerianum***

Cordylogyne mossambicense (Schltr.) Eyles = *Periglossum*

FANNINIA Harv., Gen. S. Afr. Pl. ed. 2: 235 [1868]. **Type species:** *Fanninia caloglossa* Harv.

Panninia Baill. Hist. Pl. 10: 258 [1890].

Description: *Habit:* Perennial geophytic herb; with milky latex. *Underground organ:* A smallishform stem-tuber. *Stems* usually solitary, unbranched or rarely one-branched at the base, erect, 100—250mm tall, sparsely & villously haired with white jointed trichomes. *Leaves* 2—6 pairs per plant, opposite, spreading to spreading-erect, petiolate, simple, entire; lamina ranging from ovate at stem base to lanceolate or oblong in stem middle to linear near stem apex or ovate to oblong-lanceolate through-out, 25—60mm long, 4—25mm wide, apex acute to obtuse, base usually rounded, rarely subcordate, margins entire & smooth, midvein & secondary veins prominent below, adaxial & abaxial surfaces villously haired or shortly ciliate with white jointed trichomes; petiole 2—5mm long. *Inflorescences* pedunculate, umbel-like, usually 1—2 produced terminally, 4—10-flowered; peduncles 19—60mm long & villously haired; bracts filiform, 4.5—7.0mm long. *Flowers* pedicellate, semi to fully pendulous, white to pink with dark purple corona; pedicels 8—17mm long. *Calyx* 5-merous; lobes linear to linear-lanceolate, 5.5—8.0mm long, 1.0—1.7mm wide, apex acute, abaxial surface villously haired; adaxial surface glabrous. *Corolla* deeply cup-like or spreading-campanulate, 5-merous, divided almost to the base, without a corolline corona; lobes oblong-lanceolate, 11—15mm long, 4.5—7.0mm wide, apex subacute, adaxial surface glabrous centrally, with long white hairs on the margin & near the apex, abaxial surface with sparse, long, white hairs all over. *Staminal-corona* pseudomonoseriate, dark purple in color, arising about ±2mm above the

gynostegial-column base, 5-merous; lobes almost as long as the petals, erect or slightly spreading, dorso-ventrally flattened, linear-oblong, 5.5—6.8mm long, ±2mm wide, apex with a slight depression, inner surface with a slightly thickened central keel running the length, outer surface flatish, dark purple, the base bearing 2 small fleshy lobules, 2mm long, 0.8—1.5mm wide, with the tips incurved over the anther-appendage backs & whitish. *Staminal-column* ±4.5mm tall, constricted under the corona & anther-wings & stipe-like. *Stamen*: Anther-appendages semicircular, much broader than long, margin fringed with long white hairs at their tips, inflexed over the style-apex, white, membranous. *Pollinaria*: Pollinia solitary & pendulous in each anther-sac, joined in pairs to a small corpusculum by thin translator-arms. *Style-apex* truncated & not exceeding the anthers. *Fruit* not yet know. *Etymology* Named after George Fox Fannin (1832—1865) botanical collector who farmed in the Dargle area of KwaZulu-Natal from 1847.

Discussion: This is a monospecific genus. It can be distinguished from other South African genera by its pendulous, campanulate flowers which are supported on very slender dainty solitary stems, the corolla color, petals covered in sparse, very long, white jointed hairs, and corona simple without appendages or keel-wings. The remains of a second, now vestigial, ring of corona-lobes can be seen as small lobules alternating with the main coronal whorl. N.E. Brown (1908) states that it is like *Schizoglossum eximium* and *S. grantii* from tropical Africa, unfortunately, we have not seen specimens of these species so cannot comment on this. In the southern African context, however, this genus seems to be closely linked to *Aidomene humilis* which it closely resembles in its vegetative structure, inflorescence, corolla, coronal and pollinarium features. It differs from this species in its stem-tuber being napiform rather than deep-seated and cylindrical, its pendulous flowers, anther-appendages tipped with long white hairs and corona-lobes lacking triangular keel-wings. These features are enough for it to be kept separate from *Aidomene*. *Fanninia* also resembles *Schizoglossum elingue* and *S. stenoglossum*, which in turn are also linked to *Sigridia humilis*. In fact, a good case could be made to remove

these species from *Schizoglossum*. Finally, *Fanninia* also seems to be related to the genus *Trichocodon*, having in common with this genus pendulous flowers, similar petal color and pubescence, as well as corona and pollinarium structure.

1. *Fanninia caloglossa* Harv., Gen. S. Afr. Pl. edn. 2: 235 [1868]. **Type:** *Fannin 49.* South Africa, KwaZulu-Natal province, Dargle Farm [Holo. TCD].

Discussion: Found growing in midland or highland mountain grassland, often in annually burned areas. N.E. Brown (1908) says: "This is one of the most beautiful of South African Asclepiads...". It is a delicate and most attractive plant (fig. 30) and anyone who has encountered this species, whether in the field or herbarium, has to concur with Brown's statement. *F. caloglossa* flowers from November to January, peaking in December, and occurs at altitudes of between 750 to 2500 meters.

Distribution: South African endemic [Free State, KwaZulu-Natal & Eastern Cape province only] (fig. 33). We have so far seen only one specimen from the Free State.

Conservation status: Low Risk (Near Threatened), following Scott-Shaw (1999). This rare species occurres in heavily exploited areas.

Representative Specimens: South Africa: Free State: *Stewart 1976*, Witsieshoek [NU]. KwaZulu-Natal: *Nicholas 1012*, Shawood farm, Lions River district [NH, NU]; *Buthelezi 57*, forest reserve Underberg [NH]; *Haygarth s.n., sub Wood 13044*, Ensikeni [NH]; *Wlliams 677*, Kamberg, Game Pass farm [NH]; *MacDevette 1330*, Weza State Forest [NH]; *Gordon-Gray 92*, Kamberg Nature Reserve [NU with stem-tubers]; *Killick & Vahrmeÿer 3592*, Highmoor State Forest [PRE]; *Jordaan 796*, Ngeli Mountain [PRE]; *Trauseld 359*, Giant's Castle Game Reserve [NU with stem-tuber, PRE]; *Cowan 118*, Cobham Forest Reserve [NU]; *Shirley s.n.*, Ixopo [NU 31896]; *Grice s.n.*, Fairview farm, near Underberg [NU]; *Stewart 2034*, Royal Natal National Park, Basuto Gate [NU]. Eastern Cape: *Phillipson 1157*, Menziesberg [UFH]; *Gibbs Russell 3484a*,

Figure 30. *Fanninia calaglossa*: a. & b. Whole plant showing habit & grassland habitat (*circa* 100mm tall); c. Close up of flower and; d. Holotype Fannin 49 (TCD). Photographs: a & c. by anonymous; b. by L. Greene and; d. by Kew Photographer.

Keis Kammahoek [GRA, PRE, UFH]; *Flanagan 1685*, Thomas River, near Cathcart [PRE]; *Tyson 2720*, Malowe Mountain [PRE]; *Rattray 58*, Hogsback [PRE]; *Sims 1236*, Dohne Hill [NU]; *Tyson 897*, near Clydesdale [GRA]; Stewart 1851, Elands Heights, Maclear district [NU].

TRICHOCODON (DMN Sm.) Nicholas. *Gen. et Stat Nov.*

Pachycarpus E. Mey. Section *Trichocodon* D.M.N. Sm., in Notes from the Royal Bot. Gard. Edinburgh. 41(2): 301 [1983]. **Type:** As above.

Asclepias L. Section *Campanulatae* Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Type:** As above.

Pachycarpus E. Mey. Section *Campanulati* (Schltr.) Nicholas & Goyder, in Bothalia. 20(1): 87. [1990]. **Type:** As above.

Description: *Habit:* Erect perennial geophytic herb; with milky latex. *Underground organ:* A napiform stem-tuber, 70—100mm long. *Stems* slender, erect, usually 1, occasionally up to 3, usually unbranched, occasionally branched, but then from the base only, puberulous to pubescent, 150—630mm tall. *Leaves* opposite, petiolate, spreading-erect, simple & entire; lamina usually narrowly linear, occasionally lanceolate, 45—165mm long, 1.8—9.5mm wide, apex acute to pointed, base usually cuneate, rarely obtuse or minutely truncate, margins revolute & glabrous to scabrid, adaxial surface scabrous to densely pubescent, abaxial surfaces glabrous but pubescent along prominent midrib, other veins obscure; petiole 1.5—7.0mm long. *Inflorescences* pedunculate, usually solitary & terminal, rarely 2 then terminal & lateral at the upper nodes, umbel-like, semipendulous to pendulous, 3—14-flowered; peduncles 20—70mm long, pubescent to densely pubescent; bracts usually narrowly linear, occasionally linear to linear-lanceolate, 4—15mm long, apex pointed, adaxial surface glabrous, abaxial surface

pubescent, occasionally caducous. *Flowers* pedicellate, pale green, dull creamy green, light brown, yellowish green tinted brownish or violaceous-brown outside; pedicel 12—50mm long, pubescent. *Calyx* 5-merous; lobes linear, lanceolate to narrowly ovate, 5—15mm long, 1.8—2.8mm wide, apex acute to almost pointed, adaxial surface glabrous, abaxial surface pubescent, coarsely pubescent to hirsute. *Corolla* 5-merous, campanulate, campanulate-globose to globose, 10—50mm long, divided for 3/4 to 1/4 of its length; lobes broadly ovate, elliptic, oblong-elliptic, broadly elliptic to suborbicular, 5—24mm long, 7—27mm broad, apex obtuse, slightly incurved to recurved-spreading, adaxial surface glabrous, abaxial surface densely pubescent. *Staminal-corona* arising 0.5—2.5mm above the gynostegial-column base, 5-merous; lobes free, usually radiating horizontally from the base, linear, linear-lanceolate, elliptic-oblong, obovate to compressed cucullate, 2—25mm long, ±2.5mm wide, apex acute to obtuse or rarely shortly bifid, upper keel with very small to very large obliquely triangular or deltoid wings 0.5—12mm long, 1—4.5mm tall, these broadest near the gynostegial-column & reaching the base or apex of the anther-wings or the anther-appendages, rarely with apical half erect, reaching all the way up or up to 1/4 of the lobe length, lower surface straight or rounded, dark purple sometimes with the keels paler or creamy yellow. *Staminal-column* 4.5—8.5mm tall. *Stamens*: Anther-wings 0.6—3.7mm long, vertical with straight outer edge or slightly concave & beaked basely; anther-appendages linear-oblong, ovate-lanceolate, oblong, elliptic to orbicular, 1—7mm long, apex rounded, erect, pressed against the style-stigma-head or not to overtopping the style-apex & sometimes inflexed over it. *Pollinaria* wish-bone-like; pollinia solitary, pendulous in each anther-sac, tear-drop-shaped & sometimes slightly curved; translator-arms thin & narrow; corpusculum fusiform. *Gynoecium*: carpels 2.5—4.5mm long, glabrous or covered with long soft brown hairs; style-apex truncate with margins 5-crenate & centrally depressed or stellate with lobes 1.5—3.0mm long & spreading horizontally beyond the anthers with tips obtuse or turret-like the tip with 5 fleshy contiguous erect lobes extending 2.5mm beyond

the anther-appendages. *Follicles*: Usually solitary, erect, fusiform to very narrowly ovoid, usually smooth, rarely with small longitudinal wings. *Seeds:* bifacial, dorso-ventrally flattened, obovate, shallowly concave below, convex above. *Etymology:* From the Greek *trichoma* = hairs & *-codon* = bell; in reference to the hairy bell-shaped flowers.

Discussion: The species included here were originally included in *Gomphocarpus* under his section *Campanulatus* by Schlechter (1896). However, Brown (1908) removed them to the genus *Pachycarpus* when he ceased to recognize the genus *Gomphocarpus*. Later, Smith (1988) placed them in section *Trichocodon* under *Pachycarpus*. Unfortunately, according to the **Code of Botanical Nomenclature**, Schlechter's sectional name *Campanulati*, being of the same rank and older, had to take precedence (Nicholas & Goyder, 1990). Smith (1988) based her new section on the fact that these species differed from the rest of *Pachycarpus* in their slender stems, narrow leaves, pendulous flowers, campanulate corolla and carpels covered with soft brown hairs. However, the differences are much more than these and include: Leaves in which only the midrib is prominent below (in *Pachycarpus* at least the secondary if not tertiary veins are also visible), leaf margins revolute rather than flat, corolla lobes fused for at least half of its length (in *Pachycarpus* they are free, *P. grandiflorus* being the only exception), slender rather than stout gynostegial-column, slender rather than large and very horny anther-wings, corona-lobes dark purple in color rather than greenish, yellowish-green or bright yellow, sometimes mottled purple, style-apex various versus style-apex consistently truncated and pollinaria slender versus stout, with translator-arms thin and bent at right angles as opposed to thick, broad and straight. The fruit, being fusiform to narrowly ovoid and smooth, rarely with small longitudinal wings, is also different from that of *Pachycarpus*.

The number and degree of these differences, as well as the possibly quite different evolutionary origin of these species have made us decide to place them in a genus of their own. Possibly N.E. Brown placed these species in *Pachycarpus* because the corona-lobes have a similar structure to others in the genus and because the globose corolla is

reminiscent of *P. grandiflorus*; the two taxa follow each other in his 1908 treatment. However, we believe that these characters may be due to convergence rather than similarity through a phylogenetic relationship.

The differences outlined above, such as the color of the corolla and corona, slender habit, leaf-structure, gynostegial-column (not being stout) and pollinarium structure seem to indicate that these are really related to *Aidomene* (particularly *A. humilis*) and *Fanninia* rather than *Pachycarpus*. Our decision to raise these species to generic status and place them nearer *Aidomene* and *Fanninia* was supported by a specimen (*Abbott 5459*) housed at the Natal Herbarium and which was collected on Ngele Mountain. This specimen, especially in its corona structure, but also in other features as well, is halfway between *Trichocodon campanulatus* and *Aidomene humilis*. It would be easy to assume that this is a hybrid, but *A. humilis* does not occur in this area, the nearest populations being 100 kms away in the Drakensberg. As a result, we have begun to suspect that this specimen may either be a relic or throw back to earlier times. In its corona-lobe structure this specimen resembles *Trichocodon linearis* and when examined thoroughly the similarity to *A. humilis* and *Fanninia* are also evident. It is for this reason that we have placed *T. linearis* first in our treatment. The Ngele specimen differs from *T. linearis* in its anther and gynostegial-column structure.

We have chosen to use the name *Trichocodon* in preference to *Campanulati*, this is permissible under the **Code** because a name does not have priority outside of its rank, so *Campanulati* has no priority at generic level.

Key To Species:

1a Style-apex projecting horizontally or vertically beyond the anther-appendages 2

1b Style-apex truncate not projecting horizontally or vertically beyond the anther-appendages 3

2a Style-apex star-like, consisting of 5 lobes that extend horizontally past the anther-appendages ..... *T. stelliceps*

2b Style-apex not star-like, extending vertically beyond the anther-appendages & ending in 5 fleshy contiguous lobes . ..... *T. rostratus*

3a Anther-appendages 5—7mm long ..... *T. linearis*

3b Anther-appendages 4—5mm long 4

4a Corona-lobes saccate-cucullate (helmet-shaped) ..... *T. suaveolens*

4b Corona-lobes slipper-shaped ..... *T. campanulatus*

1. ***Trichocodon linearis*** (E. Mey.) Nicholas. *Comb. Nov.* **Type:** *Drège 4969,* South Africa, Eastern Cape province, in grassland between Zandplaat and Komga at 2500 to 300ft (= 762—915m), and near Morley at 1500ft (= 457m) [Holo. B† Drawing of the type by M. Smith in K].

Lagarinthus linearis E. Mey., Comm. Pl. Afr. Austr.: 207 [1838]. **Type:** As above.

Gomphocarpus linearis (E. Mey.) Dietr., Syn. Pl. 2: 901 [1840]. **Type:** As above.

Asclepias linearis (E. Mey.) Schltr., in Journ. Bot. 34: 453 [1896], *pro parte. non* Scheele in Linnaea, 21: 758 [1848].

Asclepias tenuiflora Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896], *pro parte. tenuifolia* in error, I.K. Suppl. 2: 19 [1896—1900].

Gomphocarpus asper Decne., in DC., Prodr. 8: 561 [1844]. **Type:**

Discussion: This species is similar to *T. campanulatus* in its general appearance (fig.32), but it can be distinguished by the fact that the corona-lobe is erect in the apical half rather than completely horizontal, it is also acute at the apex rather than obtuse, the keel wings run for almost the entire length of the horizontal basal part (in this they are similar to *T. suaveolens* and *Aidomene humilis*). The most striking difference, however, is the ovate-lanceolate anther-appendages which are erect and project beyond the style-apex. We have continued to follow Smith by including *Gomphocarpus asper* as a synonym, but see her 1988 comments on this. This species is occasional in open grassveld. Plants flower from November to February, and occur at an altitude of about 100 meters. Illustrated by Smith (1980 & 1988).

Distribution: South African endemic [Eastern Cape & KwaZulu-Natal (were it borders the Eastern Cape) provinces] (fig. 34).

Conservation status: Vulnerable.

Representative Specimens: South Africa: KwaZulu-Natal: MacDevette, 1536, Lovedale, Weza State Forest [PRE corona-lobes with a touch of *T. campanulatus*]. Eastern Cape: *Baur 381*, Baziya [K]; *Sim 20285*, Fort Cunynghame [NU, PRE]; *Flanagan s.n.,* Dohne mountain [PRE 51544 fig. 32].

2. *Trichocodon campanulatus* (Harv.) Nicholas. *Comb. Nov.* **Type:** *Sanderson s.n.,* South Africa, KwaZulu-Natal province, Pearson's farm, 22nd Dec. 1853 [Holo. K Photo. NU].

Gomphocarpus campanulatus Harv., Thes. Cap. 1:61 & t.97 [1859]. **Type:** As above.

Pachycarpus campanulatus (Harv.) N.E. Br., in Fl. Cap. 4(1): 736 [1908]. **Type:** As above.

Asclepias linearis Schltr., in Journ. Bot. 34: 453 [1896], *pro parte non* E. Mey.

Asclepias tenuiflora Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896], *pro parte.*

Discussion: Like *Aidomene humilis* this is a very attractive species when encountered in the veld. A single stem is produced from a carrot-like stem-tuber. The flowers, which are very large in subspecies *campanulatus*, bend the stem so that the flowers are pendulous and often touch the ground. N.E. Brown (1908) divided this species into two varieties. We have, because they are so distinct and because they seem to breed true to form (we have seen no possible hybrid specimens), decided to treat these at subspecific level, and to add what was *Pachycarpus gerrardii* to their rank. Further details are given below.

Distribution: Southern African endemic. South Africa (in the following provinces: Eastern Cape, KwaZulu-Natal, Mpumalanga, Gauteng & Northern) and Swaziland.

Key To Varieties:

1a. Corona-lobes 9 to 17mm long; inflorescences 3 to 5-flowered ..... subsp. *campanulatus*

1b. Corona-lobes 2.0 to 8.5mm long; inflorescences (3-) 8 to 14-flowered 2

2a. Anther-appendages 3.4 to 4.5mm long ..... subsp. *sutherlandii*

2b. Anther-appendages 1mm long ..... subsp. *gerrardii*

2a. *Trichocodon campanulatus* (Harv.) Nicholas subspecies *campanulatus*. *Comb. et Stat. Nov.*

Pachycarpus campanulatus (Harv.) N.E. Br. variety *campanulatus*, in Fl. Cap. 4(1): 736 [1908]. **Type:** As for *Trichocodon campanulatus*.

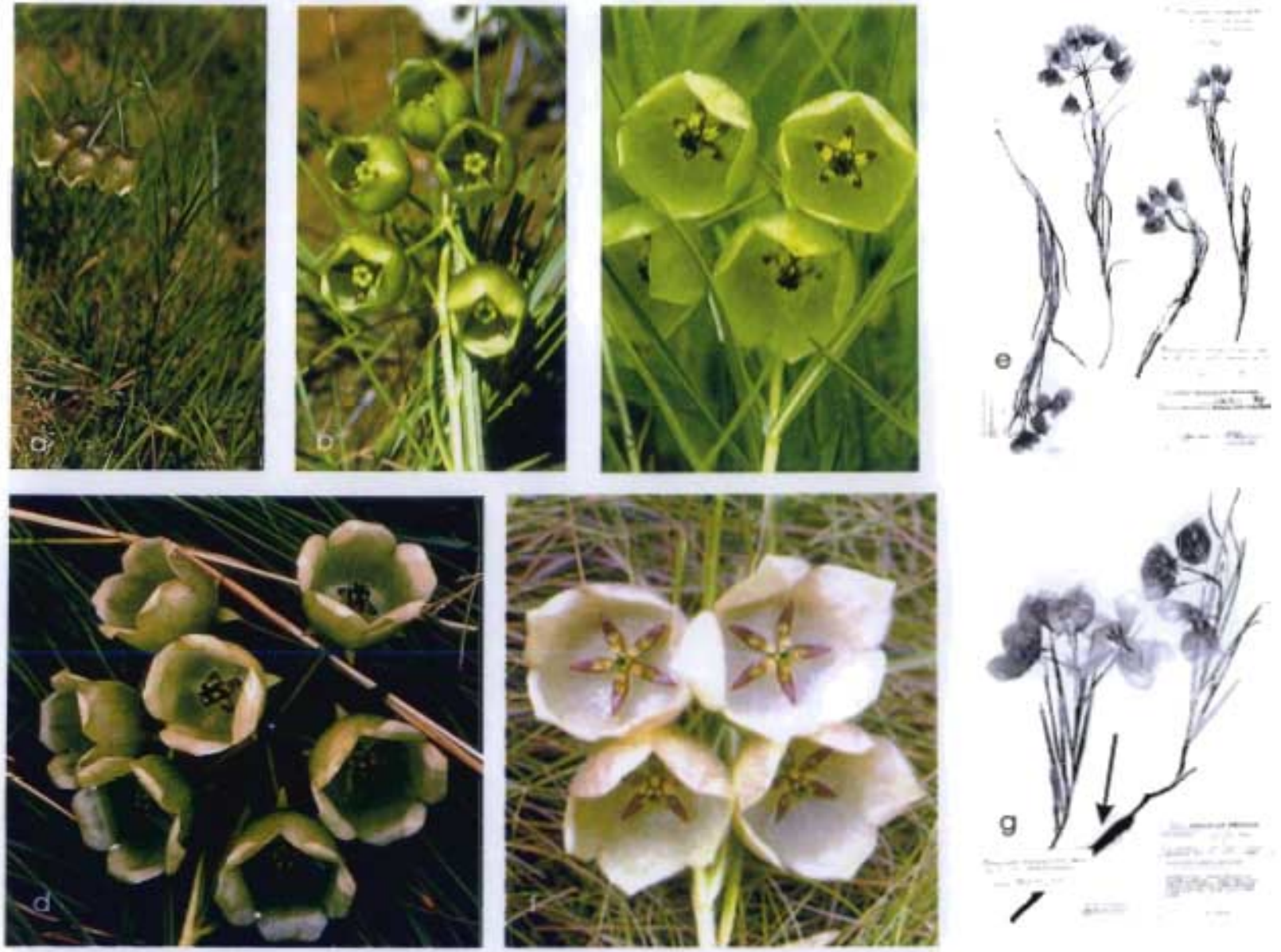

Figure 31. *Trichocodon campanulatus* subsp. *sutherlandii*: a. Whole plant showing habit & grassland habitat (200mm tall); b, c & d. Close up of flowers showing color variants and; e. Thorncroft 1106 (PRE). *T. campanulatus* subsp. *campanulatus*: f. Close up of flowers and; g. Killick & Vahrmeijer 3987 (PRE) showing carrot-like stem-tuber (indicated with an arrow) typical of this genus. Photographs: a by A. Nicholas; b by T. Abbott; c by M. van Eintak; d by anonymous; e, f & g by A. Bamps-wyly; and f by B. Wise.

Discussion: The corolla of this variety can get very large, reaching 50mm in length, in general it is bigger than in the other varieties but there is some overlap in range of variation. The corona of subsp. *campanulatus*, however, shows a distinct discontinuity in length being 9 to 17mm (fig. 31). In subsp. *sutherlandii* the corona-lobe length is 2.o to 8.5mm and in subsp. *gerrardii* it is 4.0 to 8.5mm long. This character when combined with flower number, corolla length and distribution pattern easily separate these taxa and indicate that they should be given varietal status. Being found only in the southern half of KwaZulu-Natal, subsp. *campanulatus* has a rather restricted distribution. The roots are apparently eaten during times of famine (Fox & Norwood Young, 1982). Plants are found in midland and upland grasslands. Flowering occurs from November to February, and plants are found at altitudes of between 1000 and 2000 meters. Illustrated in Harvey (1895) and Smith (1980 & 1988).

Distribution: South African endemic [KwaZulu-Natal & Eastern Cape (where it borders KwaZulu-Natal) provinces] (fig. 33).

Conservation status: Low Risk [Least Concern].

Representative Specimens: South Africa: KwaZulu-Natal: *Abbott 4980*, Ngele. [NH]; *Killick & Vahrmeÿer 3987*, Bushman's Nek [NH, PRE fig 31]; *West 1607*, Estcourt [NH flowers & fruit, PRE]; *Webb 30*, Elandskop [NU with fruit]; *Harvey 4*, Bulwer [NU]; *Evans 507*, South Downs [NH]; *Kean s.n.*, Middlefield farm, Mooiriver district [NH 63419 with drawings]; *Wylie s.n.*, Arnold's Hill, Richmond [NH]; *Bayer 790*, Rosetta [PRE]; *Fry s.n.*, Greenwich farm, Rietvlei [PRE 51526]; *Germishuizen 73*, Bushmansnek Forestry Reserve [PRE]; *Pentz 62*, Tabamhlope [PRE]; *Plowes 7103*, near Estcourt [PRE]; *Symons 283*, Giant's Castle [PRE]; *Mogg 1338*, Tweedie [PRE]. Eastern Cape: *van Nouhuys s.n.*, Insizwa Mountain, Mount Ayliff district [PRE].

2b. *Trichocodon campanulatus* (Harv.) Nicholas subspecies *sutherlandii* (N.E. Br.) Nicholas. *Comb. et Stat. Nov.* **Type:** *Gerrard 1298,* South Africa, KwaZulu-Natal province, Biggarsberg [Holo. K, photo. NU. Iso. TCD.].

Pachycarpus E. Mey. variety *sutherlandii* N.E. Br., in Fl. Cap. 4(1): 736 [1908]. **Type:** As above

Gomphocarpus linearis sensu Schltr., in Bot. Jahrb. 18(5). Beibl. 45: 20 [1894], *non* E. Mey.

Asclepias linearis sensu Schltr., in Journ. Bot. 34: 453 [1896], *pro parte, non* E. Mey. & *non* Scheele.

Asclepias tenuiflora Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896], *pro parte. tenuifolia* in error, I.K. Suppl. 2: 19 [1896—1900].

Discussion: This subspecies is distinguished by its 8 to 15-flowered inflorescences, although these may also, on occasion, only be as few as 3, smaller corolla (15 to 50mm in diameter) and smaller corona-lobes (fig. 31). Smith (1980) points out that the corona of some specimens have keel-wings that run the lobe length making them look boat-shaped; in this they begin to approach *T. suaveolens*. This is particularly prevalent in Swaziland specimens many of which are halfway between subsp. *sutherlandii* and *T. suaveolens* (*Dlamini s.n.* PRE 31186 and *Compton 25422 & 28487*); this local ecotype may be worthy of some nomenclatural recognition. These specimens support our hypothesis concerning the evolutionary pathways taken by corona-lobe within *Trichocodon* (Nicholas & Goyder, 1990). However, corona-lobe variation can be quite considerable even on the same plant, including the type where the keel-wings can vary from being fin-like and longer than tall to rabbit-ear like and taller than long. Subsp. *sutherlandii* is much more widely distributed than the type subspecies. Plants grow in annually burnt grasslands (usually highland sourveld), often in rocky areas. This species flowers from November to May, peaking December to January, and found at altitudes of between 1100 and 2100 meters. Illustrated by Smith (1980 & 1988).

Distribution: Southern African endemic. South Africa [Northern, Gauteng, Mpumalanga, KwaZulu-Natal & Eastern Cape provinces] and Swaziland (fig. 33).

Conservation status: Vulnerable to threatened in some areas.

Representative Specimens: South Africa: Northern: *Junod 4285,* Zoutpansberg [PRE]; *Mogg 13986*, Woodbush, Pietersburg [PRE]; *Marais 92*, The Downs, Letaba [PRE]. Gauteng: *Reck s.n.,* Commando Nek [PRE]; *Repton 424*, Roberts Heights [PRE]. Mpumalanga: *Jenkins 6808,* Belfast [PRE]; *Thorncroft 1106*, Lomati Valley, Barberton [PRE fig. 31]; *Jacobsen & Clinning 45*, Groothoek farm, Wakkerstroom [PRE]; *Burtt Davy 2967*, Vlakfontein Beacon, Caroline district [PRE]; *Smut & Gillett 2337*, Mauchsberg, Sabie [PRE]; *Pole Evans s.n.*, near Belfast [PRE 51498]; *Acocks 16609*, Middleburg [PRE]; *Galpin 14444*, Graskop [PRE]; *Story 5415*, Pilgrims Rest [PRE]; *Hofmeyer 51511*, Godwin river, Berlin [PRE]. Free State: *Jacobsz 612*, Rensburgskop, Swinburne [PRE]; *Blom 157*, Sterkfontein [PRE]; *Müller & Viljoen 55*, Harrismith [PRE]. KwaZulu-Natal: *Nicholas 1060,* Oliver's Hoek Pass [CPF, NH, NU]; *Nicholas 2085*, Weza State Forest [CPF, PRE]; *Edwards 62*, Amajuba Mountain [NU]; *Wood 5151*, near Charlestown [NH with drawing]; *Wood 11223*, van Reenen [NH, PRE]; *Acocks 10105*, Champagne Castle [NH]; *Harriss 157*, Rugged Glen Nature Reserve [NU]; *Harriss 132*, Retirement farm, Utrecht district [NU with stem-tube]; *Germishuizen 29*, Cathedral Peak Forest Station [PRE]; *Harrison 5*, Lions River [PRE]; *Galpin 1711*, Cathkin Park [PRE]; *Wood 8702*, VanReenen [PRE]; *Sutherland s.n.*, without precise locality [PRE 14435]; *Galpin 1259*, Kamthlobani [PRE]. Eastern Cape: *Tyson 1438*, Kokstad [PRE, SAM]; *Flanagan 2774*, Encoba Mountain [PRE]; *Boardman 6A*, Ramatsiliso's Gate [PRE]; Schlechter 6412, Mount Frere [PRE]. **Swaziland:** *Compton 25502*, Ukutula, Mbabane district [NH, PRE]; *Compton 27395*, Hawane fall [PRE]; *Dlamini s.n.*, Forbes Reef [PRE 31186]; *Compton 28487*, Enlembe [PRE]; *Compton 25422*, Ukutulu [PRE].

2c. *Trichocodon campanulatus* (Harv.) Nicholas subspecies *gerrardii* (Harv.) Nicholas. *Comb. et Stat. Nov.* **Type:** *Gerrard 1299,* South Africa, KwaZulu-Natal Province, Ngome [Holo. TCD. Iso. K].

Gomphocarpus gerrardii Harv., Thes. Cap. 2: 59 & t.193 [1863]. **Type:** As above.

Schizoglossum gerrardii (Harv.) Benth & Hook.f. ex Ind. Kew. 2: 826 [1896]. **Type:** As above.

Asclepias gerrardii (Harv.) Schltr., in Journ. Bot. 34: 453 [1896]. **Type:** As above.

Pachycarpus gerrardii (Harv.) N.E. Br., in Fl. Cap. 4(1): 737 [1908]. **Type:** As above.

Discussion: Smith (1988) sunk this taxon under *sutherlandii* because she felt that it only differed in the size of its corona. We have examined the type at Kew and also seen two specimens at NH that it matches. These specimens differ in the degree of corolla synorganization (being fused for 3/4 to 1/2 of their length), shape (more tightly globose-campanulate and more constricted at the tube mouth) and size (16 to 18mm). Also the corona, besides being smaller (4.0 to 4.5mm long, 1.7mm) and quite differently shaped (oblong-linear, flat, apex round and with two triangular keel-wings basely with their highest part proximally). As a result, we have opted to take it out of synonymy. A case could even be made for giving it specific status, however, we have decide rather to treat it as a subspecies under *T. campanulatus*. Illustrated by Harvey (1863, however, the corolla here is not accurate).

Distribution: South African endemic [KwaZulu-Natal (northern part) province only] (fig. 33).

Conservation status: Endangered. Only known from three specimens, one collected over a hundred years ago the other two 83 years ago. It must be considered endangered.

Representative Specimens: South Africa: KwaZulu-Natal: *Haygarth s.n.*, Entumeni [NH 16059 & NH 12986 with drawing].

3. *Trichocodon suaveolens* (Schltr.) Nicholas. *Comb. Nov.* **Type:** *Schlechter 4109,* South Africa, Mpumalanga Province, Olifants River [Lecto. K; Isolecto. BM, GRA, NH, PRE fig. 32]. *Schlechter 4006*, South Africa, Gauteng province, Elandspruit, in hilly grasslands, 19 Dec. 1893, alt. 6800ft (= 2073m.) [Syn. B†].

Gomphocarpus suaveolens Schltr., in Bot. Jahrb. 20(5). Beibl. 51: 38 [1958]. **Type:** As above.

Asclepias suaveolens (Schltr.) Schltr., in Bot. Jahrb. 21(5). Beibl. 54: 9 [1896]. **Type:** As above.

Pachycarpus suaveolens (Schltr.) Nicholas & Goyder, in Bothalia 20(1): 88 [1990]. **Type:** As above.

Asclepias macra Schltr., in Journ. Bot. 34: 456 [1896]. **Type:** As above.

Discussion: This species was transferred to the genus *Pachycarpus* before our suspicion that the group of species to which it is allied should not belong there (Nicholas & Goyder, 1990). However, it does clearly belong to *Trichocodon* rather than *Pachycarpus*; as defined in this paper. This species has a sac-like corona-lobe sinus; which is why it was placed in *Asclepias* by Brown (1908). It is this character that immediately distinguishes it from all other species in the genus. However, this sinus has been produced only because the keel-wings have become extremely large and almost confluent with the basal portion. Other distinguishing features include the almost completely fused corolla and corona-lobes level with or slightly overtopping the style-apex (fig. 32). Swaziland specimens have come to light since our 1990 publication. This species if found in annually burned or short grasslands. Plants flower from December to January and occur at altitudes of between about 1400 and 2000 meters. Illustrated in Nicholas & Goyder (1990).

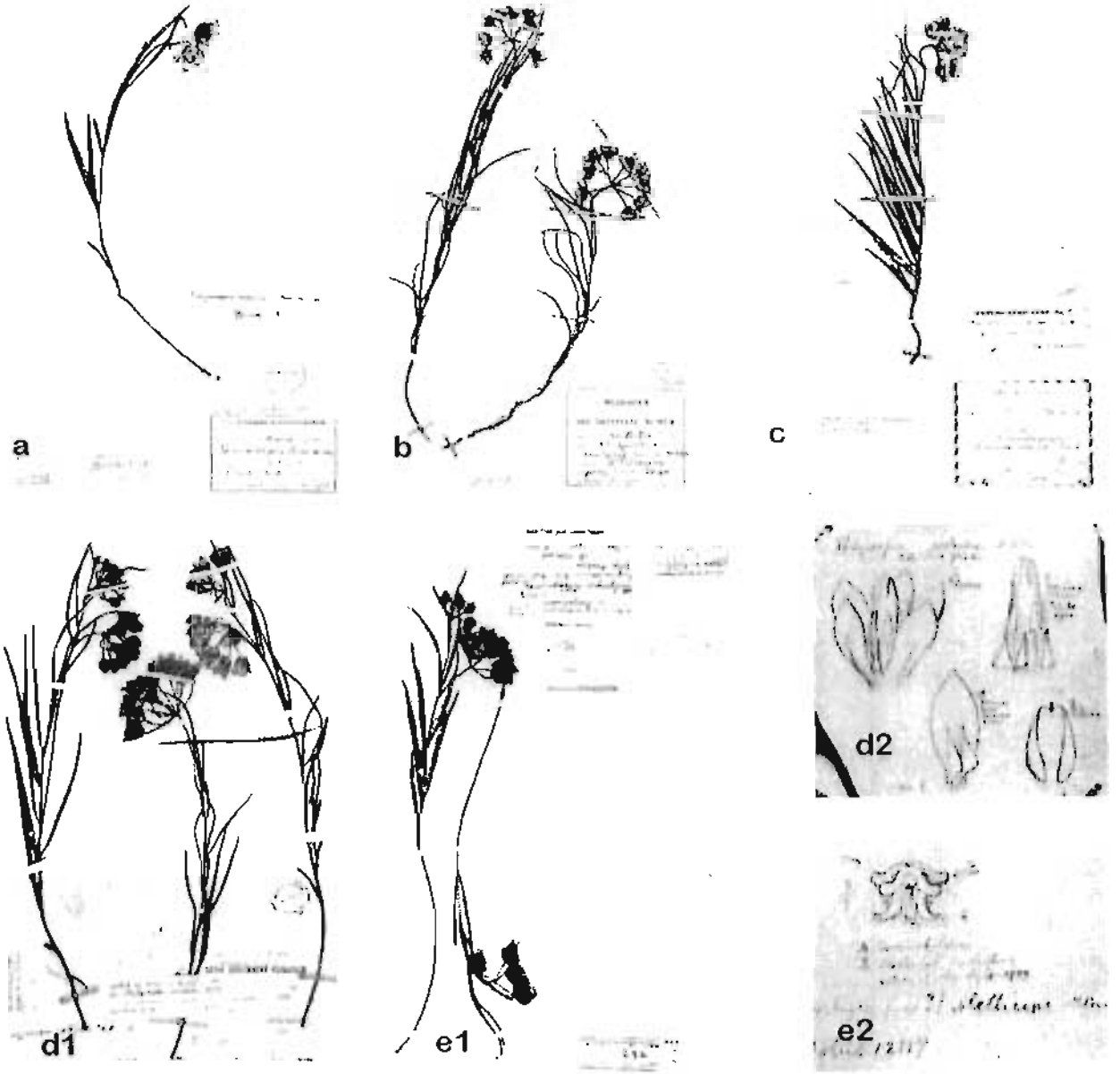

Figure 32. *Trichocodon linearis*: a. Flanagan *s.n.* (PRE 51544). *T. suaveolens*: b. Scheepers 15043 and; c. Isolecto Schlechter 4109 (PRE). *T. rostratus*: d1. Isotype Wood 7543 (NH); d2. Enlargement of drawing on type specimen. *T. stelliceps*: e1. Holotype Bolus 12117 (K); e2. Enlargement of drawing on type specimen. Photographs by A. Romanowsky National Botanical Institute.

Distribution: Southern African endemic [Gauteng & Mpumalanga provinces only] and Swaziland (fig. 34).

Conservation status: Vulnerable. Only known from six specimens, four of which occur in two heavily exploited provinces: The one, Gauteng, by industry and the other, Mpumalanga, by agriculture and aforestation. It must be considered vulnerable in Mpumalanga and possibly extinct in Gauteng.

Representative Specimens: South Africa: Gauteng: *Flugge-de-Smit ex Moss 18178*, Johannesburg, Dersley golf course [PRE with photo.]. Mpumalanga: *Scheepers 15043*, Spitskop, Ermelo [PRE fig. 32]; *Burtt Davy 2956*, near Bosses, Carolina area [K]; *Jenkins 6808*, Belfast [GRA]. **Swaziland:** Hilliard s.n., Forbes Reef [PRE 31184 corona-lobes with a touch of *T. campanulatus* subsp. *sutherlandii*]; *Karsten s.n.*, Mbabane, near Leper Station [PRE 31185].

4. *Trichocodon rostratus* (N.E. Br.) Nicholas. *Comb. Nov.* **Type:** *Haygarth ex Wood 7543*, South Africa, KwaZulu-Natal Province, 20th Dec. 1898 [Holo. K. Iso. NH with drawings fig. 32].

Pachycarpus rostratus N.E. Br., in Fl. Cap. 4(1): 738 [1908]. **Type:** As above.

Discussion: The style-stigma-head of this species, like that of *T. stelliceps*, is quite extraordinary. It projects, turret-like, way beyond the anther-appendages which are forced to stand erect along its side (fig. 32). Apically it is divided into five erect, fleshy, contiguous teeth. The inflorescences and corona-lobes otherwise closely resemble those of *T. campanulatus* subsp. *gerrardii*. However, it differs from this species not only in its style-apex but less globose and larger flowers. We do not believe this to be an aberrant form of *T. campanulatus*. Plants flower in about December. Illustrated in Smith (1980 & 1988).

Distribution: South African endemic [KwaZulu-Natal province only] (fig. 34).

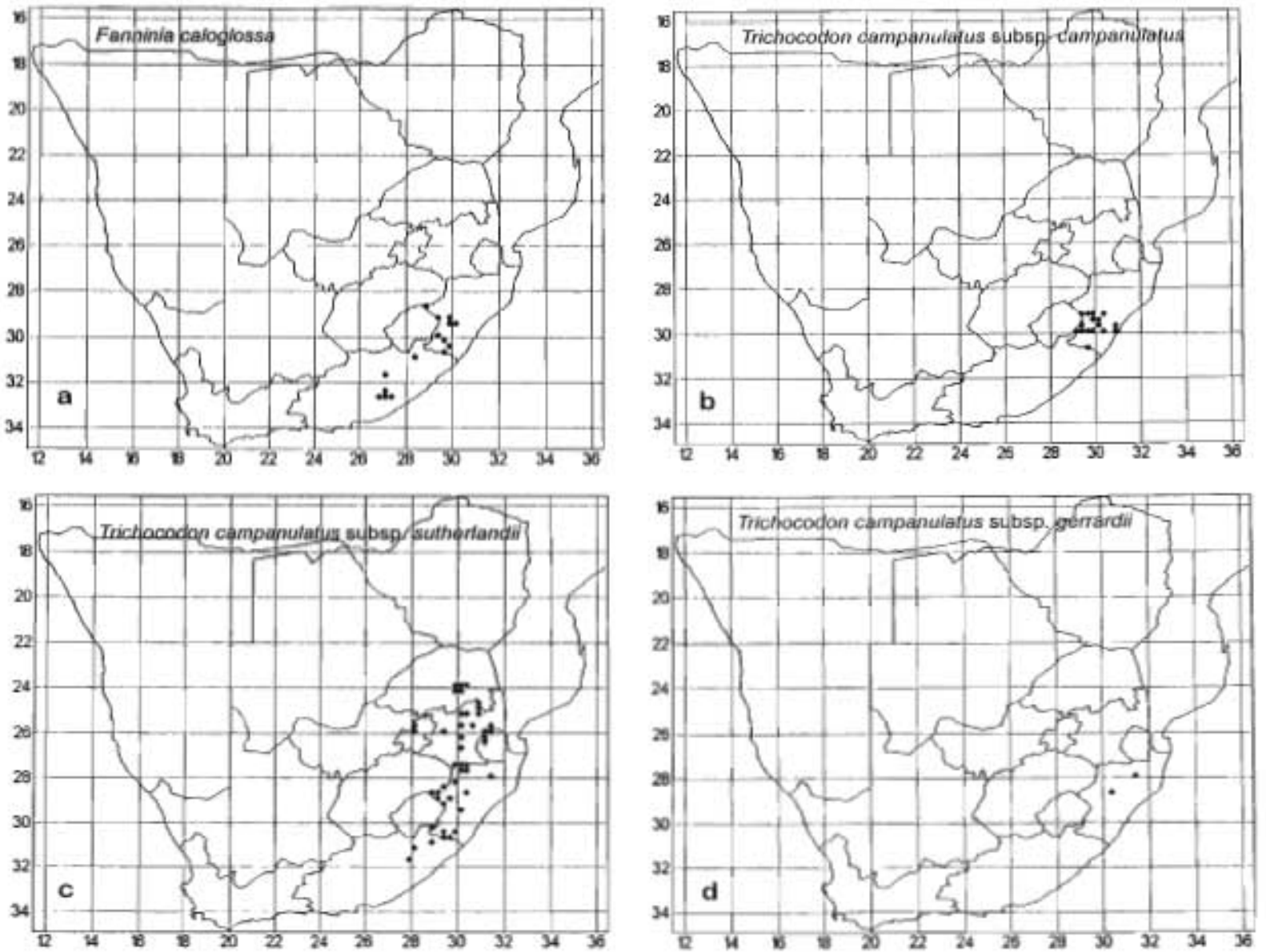

Figure 33. Distribution maps of: a. *Fanninia caloglossa*; b. *Trichocodon campanulatus* subsp. *campanulatus*; c. *T. campanulatus* subsp. *sutherlandii* and; d. *T. campanulatus* subsp. *gerrardii*.

Conservation status: Critically endangered, although Scott-Shaw (1999) considers it endangered. However, it is known from only one specimen collected 100 years ago and may possibly even be extinct. However, we do agree with conservationists that rarity and endangerment are not necessarily the same thing.

5. *Trichocodon stelliceps* (N.E. Br.) Nicholas. *Comb. Nov.* **Type:** *Bolus 12117*, Swaziland, near Mbabane, in grassland on the highveld, 1676m [Holo. K fig. 32].

Pachycarpus stelliceps N.E. Br., in Fl. Cap. 4(1): 738 [1908]. **Type:** As above.

Discussion: This extraordinary species is immediately distinguished from all others in the genus by its star-shaped style-stigma-head, which protrudes horizontally (rather than vertically as in *T. rostratus*) beyond the anther-appendages and the structure of its corona (fig. 32). The corona-lobes have the basal keel-wings long, erect, apressed to the gynostegial-column and reaching to the level of the anther-appendages. The basal horizontal part of the lobe is short with the keel-wings becoming shallow and reaching to the lobe apex. Another unique feature in the genus is that the anther-appendages of this species are broadly obovate. Otherwise, *T. stelliceps* is similar to *T. campanulati* subsp. *gerrardii* and *T. linearis*. Both N.E. Brown (1908) and Smith (1988) report the erect portion of the keel-wings to be apically bifid, however, two of the flowers we have dissected (one from each of the specimens on the type sheet) showed this feature to be entire and obtuse. This character is possibly variable within the same specimen. We do not believe this to be an aberrant form of *T. campanulatus* subsp. *sutherlandii* as suggested by Smith 1980; it is at once remarkable and unique. Fortunately, a further specimens has come to light since Smith (1988) revision. Plants flower about December. Illustrated in Smith (1980 & 1988).

Distribution: Swaziland endemic (fig. 34).

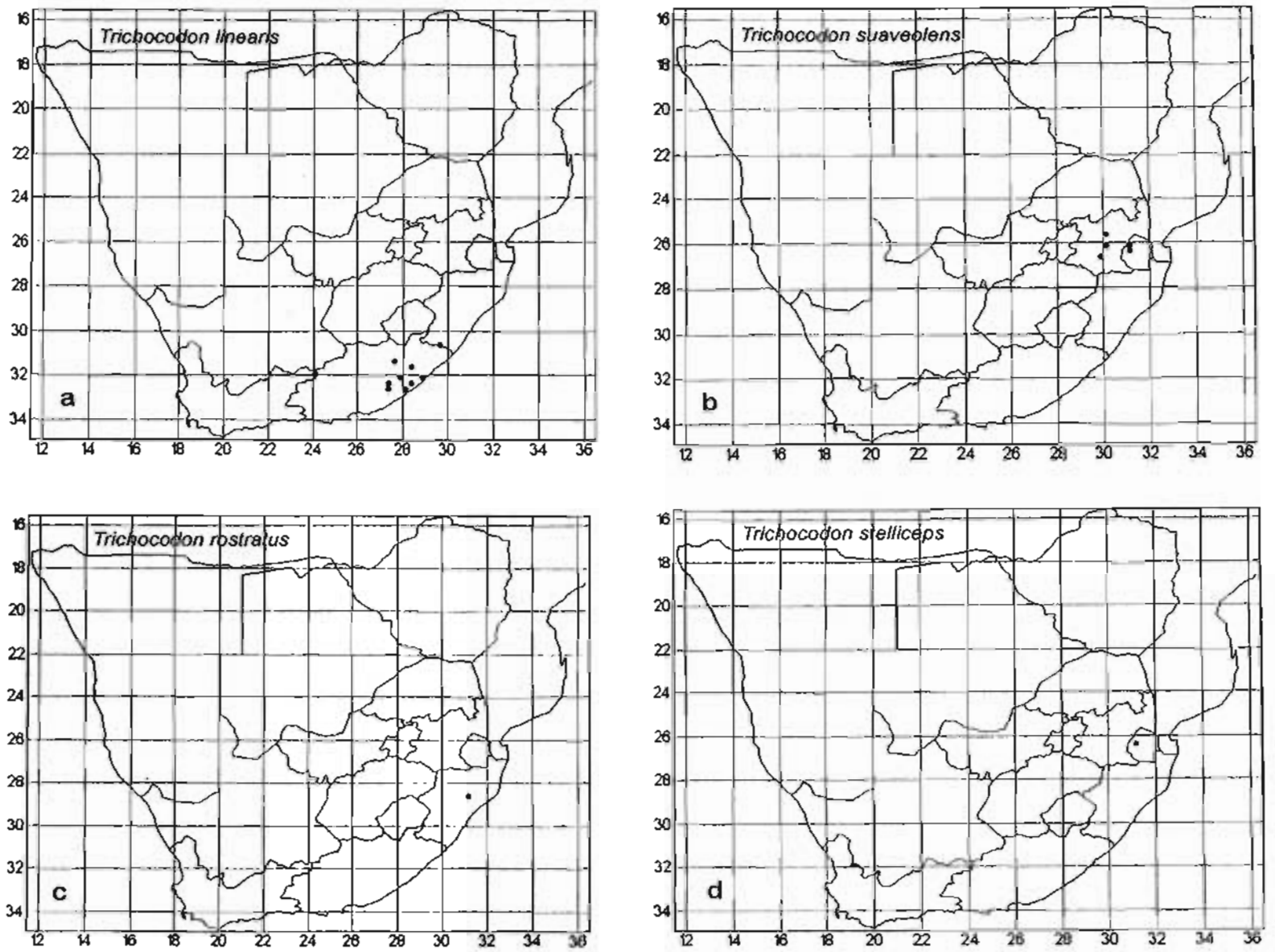

Figure 34. Distribution maps of: a. *Trichocodon linearis*; b. *T. suaveolens*; c. *T. rostratus* and; d. *T. stelliceps*.

Conservation status: Critically endangered. Known from only two specimen one collected over 90 years ago. Also occuring in the vacinity of Mbabne the capital of Swaziland, which is highly urbanized, this species must be considered endangered if not extinct.

Representative Specimens: Swaziland: *Compton 25331,* Stroma [PRE].

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APPENDIX TO CHAPTER 4.3

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ASCLEPIADACEAE

CORONA LOBE VARIATION AND THE GENERIC POSITION OF *ASCLEPIAS MACRA*

INTRODUCTION

Generic concepts in parts of the tribe Asclepiadeae have in the past varied greatly. This was partly due to a lack of insight into the evolutionary trends underlying the variation seen in coronal morphology in the tribe.

Baillon (1890), unable to establish well circumscribed genera in the tribe Asclepiadeae, sank most of the African members into one large super-genus to which he applied the name *Asclepias*. N.E. Brown (1902, 1907–1909) had a better understanding of the variation he encountered and produced a workable classification that has served us well for over 80 years. He relied heavily on corona lobe morphology and genera were often separated from each other on single characteristics. In Brown's system *Asclepias* was distinguished from all other genera in the tribe solely on the possession of a corona lobe sinus. Recent work in *Asclepias* sensu N.E. Brown (Nicholas 1981) has highlighted the fact that distantly related groups have occasionally followed the same evolutionary pathways ending up with coronal characteristics that are analogous rather than homologous. Species with such analogues have in the past been lumped together into genera that form more or less workable units but do not reflect underlying evolutionary realities or affinities. Three distinct evolutionary trends can be seen in corona lobe morphology: 1, reduction to a blob-like structure. Continuation of this trend leads to the eventual disappearance of the lobe; 2, ornamentation, namely increasing ornamentation by the production of wings and/or proximal, distal and sinal appendages (Figure 23). These can be produced singly, together or in various combinations; 3, saccation or the production of a corona lobe sinus, which may result from the development of wings and/or appendages (Figure 23).

In *Flora capensis* the genus *Pachycarpus* was distinguished from others in the tribe Asclepiadeae by its slipper-like corona lobes that may possess two parallel wings proximally on the upper surface of the keel. In addition, the distal end of the keel may become either extended or ornate.

The species long known as *Asclepias macra* Schltr. was originally described by R. Schlechter in 1895(a) under the name *Gomphocarpus suaveolens* Schltr. Later that same

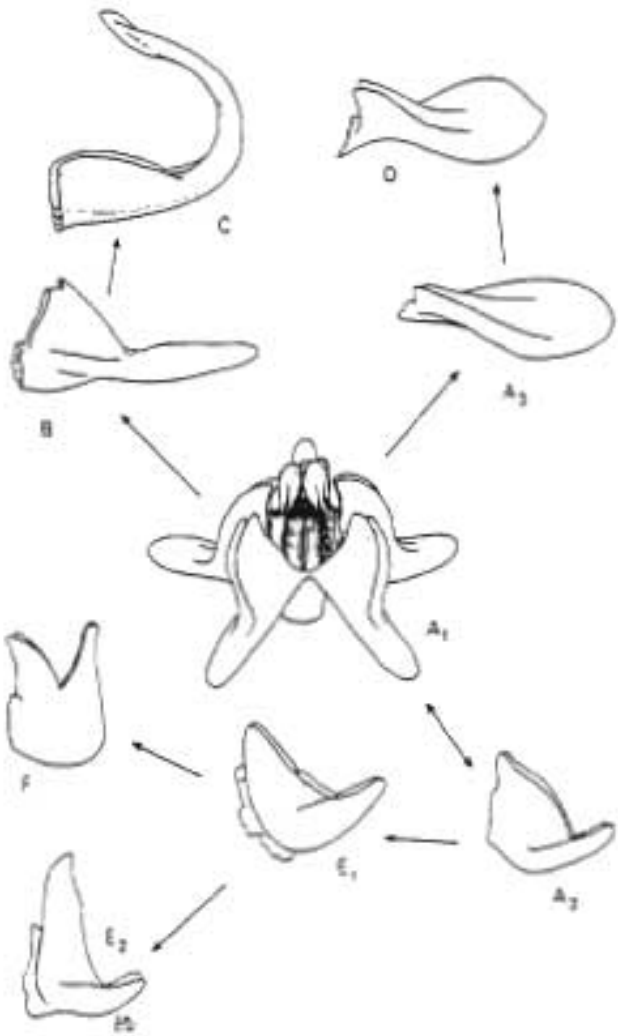

FIGURE 23.—Corona lobe variation in *Pachycarpus* section *Campanulati* showing trends towards both ornamentation and saccation. A1, A2, *P. campanulatus* var. *sutherlandii*, *Gerrard 1298*, (K). A1, gynostegial column; A2, corona lobe; A3, corona lobe of the type of *P. gerrardii*, now considered synonymous with *P. campanulatus* var. *sutherlandii*, *Gerrard 1299*, (K). B, *P. campanulatus* var. *campanulatus*, *Sanderson s.n.*, (K). C–F, corona lobe: C, *P. linearis*, *Baur 381*, (K); D, *P. rostratus*, *Haygarth ex Wood 7543*, (K); E1, E2, *P. stelliceps*, *Bolus 12117*, (K); F, *P. suaveolens*, *Schlechter 4109*, (K). All drawings × 3.

year he sank *Gomphocarpus* into synonymy under *Asclepias* (Schlechter 1895b) and transferred all the known species of *Gomphocarpus*, including *G. suaveolens*, to this genus (Schlechter 1896a). Having done this, Schlechter then noticed that the name *Asclepias suaveolens* had already been used by Leconte and cited by Decaisne in De Candolle's *Prodromus* (1844). He therefore proposed the new name *Asclepias macra* for the taxon (Schlechter 1896b). This latter name was adopted by N.E. Brown in *Flora capensis* and has been used in all subsequent literature. However, Leconte's name was never validly published and according to Decaisne (1844) is no more than an annotation on a herbarium sheet in the Muséum National d'Histoire Naturelle, Phanérogamie, Paris (P). As a result *Gomphocarpus suaveolens* is the correct basionym and *Asclepias macra* should be considered a synonym. Ongoing research into the tribe Asclepiadeae has highlighted the fact that the taxon originally described as *G. suaveolens* should be placed in the genus *Pachycarpus* E. Mey. section *Campanulati* (Schltr.) A. Nicholas & D.J. Goyder.

Brown (1907) excluded *Asclepias suaveolens* from the genus *Pachycarpus* because it possessed a distinct corona lobe sinus, although he did notice its similarity to this genus—'this remarkable species is so exceedingly like *Pachycarpus gerrardi*, N.E. Br., as to be easily mistaken for that plant until the corona is examined'. However, if one examines the corona lobe variation in *Pachycarpus* section *Campanulati*, the progression towards a corona lobe sinus can be clearly seen (Figure 23). *P. suaveolens* represents the end point of the evolutionary trend towards saccation by species in this section. If the plant is viewed in its entirety, there is little doubt that its affinities lie with this section and not with *Asclepias* sensu *Flora capensis* (Table 3). The trend towards sinus production has also occurred in section *Pachycarpus*, a fact hinted at by Bullock (1953), who included species like *P. lineolatus* (Decne.) Bullock and *P. schweinfurthii* (N.E.Br.) Bullock in the genus. These species were previously placed in *Asclepias* because they possess a corona lobe sinus.

Pachycarpus section *Campanulati* is distinguished from all other taxa within the tribe Asclepiadeae by the character combination of linear to narrowly lanceolate leaves with revolute margins, single erect stems that bear nodding inflorescences and campanulate flowers with a hairy ovary.

Obscure characters shared with section *Campanulati*, such as the beak-like shape of the anther wings and the unusual multicellular brown hairs which may sometimes be found on the ovary, also clearly establish the affinity of *P. suaveolens* with this section.

Pachycarpus *E. Mey.* Section **Campanulati** *(Schltr.) A. Nicholas & D.J. Goyder*, comb. nov.

Asclepias L. Section *Campanulatae* Schltr. in Botanische Jahrbücher 21: 9 (1896a). *Pachycarpus* E. Mey. Section *Trichocodon* D.M.N. Smith: 300 (1983); Smith: 399–439 (1988). Type.—*Pachycarpus campanulatus* (Harv.) N.E. Br., chosen here.

Pachycarpus suaveolens *(Schltr.) A. Nicholas & D.J. Goyder*, comb. nov.

Gomphocarpus suaveolens Schltr. in Botanische Jahrbücher 20: 38 (1895a). *Asclepias suaveolens* (Schltr.) Schltr.: 9 (1896a). *Asclepias macra* Schltr.: 456 (1896b); N.E. Br.: 670–671 (1907). Types.—Transvaal 2529 (Witbank): Olifants River (–CD), *Schlechter 4109* (K, lecto., chosen here; BM, GRA, NH, PRE! isolecto.). 2530 (Lydenburg): Elandspruitberg (–AA), *Schlechter 4006* (syn., not seen by the authors).

DESCRIPTION

Perennial herb. *Rootstock* not seen. *Stem* single, erect to suberect, 205–275(–400) mm high, bifariously strigose, younger parts pilose. *Leaves* erect or slightly spreading, linear to narrowly lanceolate, (45–)65–105 (–152) × (1,8–)2,5–5,0 mm, apex acute, base minutely truncate (almost minutely auriculate) to attenuate, sparsely hairy, margins revolute; petiole 2,0–4,5 (–7,0) mm long. *Inflorescence* umbelliform, semipendulous to pendulous, terminal, rarely axillary, 1(–3) per plant, 5–10-flowered; peduncles 20–27(–67) mm long. *Flowers* 17–24 × 9–15 mm; pedicel 15–20 mm long. *Sepals* lanceolate to ovate, (0,4–) 5,0–8,0 × 1,8–2,8 mm, hirsute. *Corolla* subglobose campanulate, petals fused for ⅔ their length, 11,5–16,0 × 7,0–9,5 mm, occasionally with long multicellular brown hairs outside; lobes (3,5–)5,0–7,0 × 7,0–9,5 mm, apices rounded and reflexed. *Gynostegial*

TABLE 3.—Morphological comparison of *Pachycarpus suaveolens* with *Asclepias sensu Flora capensis* and *Pachycarpus* section *Campanulati*

Characteristic	*Asclepias sensu Flora capensis*	*Pachycarpus suaveolens*	Section *Campanulati*
Stem number	Single to many	Single	Single
Stem orientation	Erect to decumbent	Erect	Erect
Leaf shape	Linear to ovate	Linear	Linear
Inflorescence	Erect to pendulous	Pendulous	Pendulous
Petals	Free almost to the base	Connate for most of their length	Connate for most of their length
Corolla	Cup-shaped or reflexed, never campanulate	Campanulate	Campanulate
Corona lobe sinus	Present	Present	Absent
Ovaries	Glabrous	Hairy	Hairy

stalk 0,5–0,8 mm. *Corona lobes* fused basally, lobes compressed cucullate, 3,2–4,0 × 4,8–5,2(–6,0) mm; appendages more or less level with style apex, proximals usually just over-topping it; proximal appendages broadly falcate, almost unguiform, 1,0–2,0 × 1,5–3,0 mm, distal appendage finger-like, bifid apically with ± 1,3 mm long cleft, 0,7–1,6(–2,4) × (0,8–)1,2–2,0 mm: keel rounded; sinus a central slit, puberulous inside, ± 1,8 mm deep. *Anthers*: anther wings beak-like, 0,6–1,0 × 1,5–2,1 mm; anther appendages tongue-like, 1,3–2,0 × 1,2–1,5 mm, decumbent on the style apex, apex rounded. *Style apex* truncate with a central depression and 5 crenulate, almost flanged outer lobes, whitish, 3,0–4,0 mm in diameter. *Pollinarium*: pollinia golf-club-shaped, 0,5–1,0 × 1,1–1,25 mm; translator arms minutely winged at junction with corpusculum, (0,4–)0,6–0,8 mm long; corpusculum fusiform, 0,14–0,2(–0,3) × 0,2–0,4(–0,6) mm. *Ovaries* covered in long, brown, multicellular hairs. *Fruit & seed* not seen. Figure 24.

TRANSVAAL.—2529 (Witbank): Olifants River (–CD), *Schlechter* 4109 (BM, GRA, K, NH, PRE). 2628 (Johannesburg): Dersley Golf course near Geduld (–AB), *Flugge-de-Smit ex Moss 8878* (PRE). 2629 (Bethal): Spitskop, Ermelo (–BD), *Scheepers 15043* (PRE). 2630 (Carolina): near Bosses (–?), *Burn Davy 2956* (K).

The morphological affinities of *Pachycarpus suaveolens* lie most closely with *P. campanulatus* var. *sutherlandii* N.E. Br. However, it can be distinguished from this and all other taxa in section *Campanulati* by its distinct, centrally placed corona lobe sinus. The key published by Smith (1988) has been revised to include *P. suaveolens* and is presented below.

1a Style apex with margins extended laterally beyond or vertically above the anther appendages:
  2a Style apex forming 5 lobes which extend horizontally past the anther appendages; appearing stellate from above ..... *P. stelliceps*
  2b Style apex extending vertically above the anther appendages, terminating in 5 small erect lobes; never appearing stellate from above ..... *P. rostratus*
1b Style apex with margins never extended laterally beyond or vertically above the anther appendages:
  3a Anther appendages 5,0–7,0 mm long ..... *P. linearis*
  3b Anther appendages 0,5–4,0 mm long:
    4a Corona lobe saccate-cucullate without large proximal wings on the adaxial surface of the keel ... *P. suaveolens*
    4b Corona lobe slipper-shaped with large proximal wings on the adaxial surface of the keel:
      5a Corona lobes 3,0–8,5 mm long. Inflorescences 3–40-flowered ..... *P. campanulatus* var. *sutherlandii*
      5b Corona lobes 9,5–17,0 mm long. Inflorescences never more than 5-flowered ..... *P. campanulatus* var. *campanulatus*

Pachycarpus suaveolens is a rarely collected southern Transvaal endemic (Figure 25). Like the other species in section *Campanulati*, this attractive plant is found in annually burnt or cut grasslands. It flowers between December and January and as such appears to have a rather short flowering period. Only the two specimens collected by Rudolf Schlechter have altitudes recorded—these being 2 040 m and 1 460 m. The rootstock, fruit and seeds have neither been recorded nor collected. Flower colour has not been recorded either and it is difficult to tell from the dried specimens what colour they would have been.

FIGURE 24.—*Pachycarpus suaveolens*. *Schlechter 4109*, (K): A, whole plant × 0,5; B, transverse section through leaf showing revolute margins × 3; C, flower with corolla splayed × 1,5; D, gynostegial column showing shape of corona lobes × 2; E, pollinarium × 7,5.

FIGURE 25.—Presently known distribution of *Pachycarpus suaveolens*. Map scale 4 mm = 100 km.

However, it is likely that they are brownish with a hint of green and purple. One dissected flower (*Flugge-de-Smit ex Moss 18178*) showed a pollinium (in situ) from which a mass of pollen tubes had started to germinate, probably

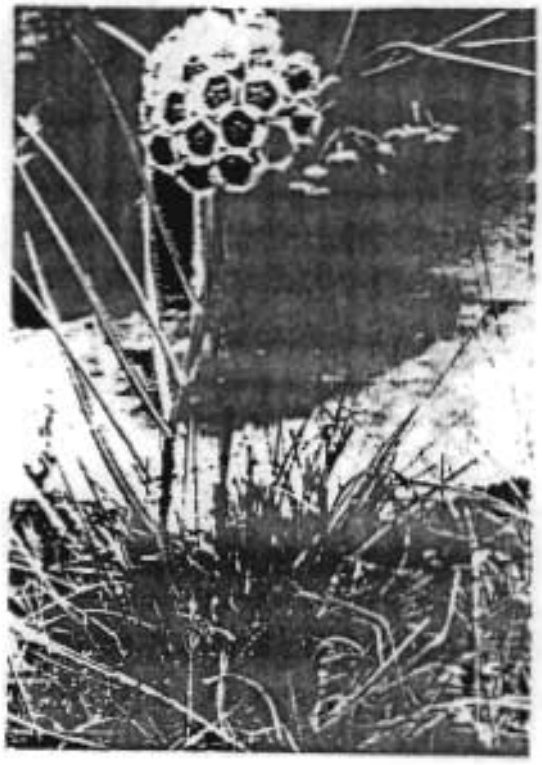

FIGURE 26.—Photograph of *Pachycarpus suaveolens* showing the habit of the plant. Note the single erect stem with its many-flowered, pendulous inflorescences. Photograph of *Flugge-de-Smit ex Moss 18178*, PRE.

evidence of an attempt at self pollination. Had the specimen not fallen prey to a plant press one wonders if this attempt would have been successful.

In the field *P. suaveolens* must look a fine sight with its single, almost erect stem bearing a collection of eight or more densely crowded campanulate flowers in a nodding inflorescence. Figure 26.

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A. NICHOLAS* and D.J. GOYDER**

* National Botanical Institute, Private Bag X101, Pretoria 0001. Presently: South African Liaison Botanist, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, England, UK.

** The Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, England, UK.

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CHAPTER 4.4

SCHIZOGLOSSUM & ALLIED GENERA

"*Schizoglossum* is a model genus, one that could be taken as an example of the concept 'genus' for teaching purposes. It is clearly separated from the remainder of the tribe Asclepiadeae, it is compact, comprising only a dozen species endemic to southern Africa, and it displays a rich diversity of variable characters."

— Kupicha, 1984.

CONTENTS

INTRODUCTION

The genus *Schizoglossum* was proposed by Meyer (1838) based on a nucleus of six species. In this same work he also proposed the genus *Aspidoglossum* (with six species) and *Lagarinthus* (with 19). Bentham (1876) sunk all of these under a much expanded *Schizoglossum* (although a number of species previously placed in *Lagarinthus* were subsequently transferred to *Asclepias* by subsequent authors). Several authors subsequently added to the genus, in particular Schlechter who worked extensively on the African flora (1893 to 1913) and Schumann (1895). Huber (1967) and Dyer (1971) expanded the circumscription further by sinking *Stenostelma* Schltr. into *Schizoglossum*.

By the time N.E. Brown (1907) revised the genus for the **Flora Capensis**, it was the second largest (98 species) in the subcontinent. With some 107 species, *Stapelia* L. beat it by only 18 species. The next largest genus within the subtribe Asclepiadinae was *Asclepias* L. with 57 species. All three of these large genera have subsequently proved to be polyphyletic and have been redefined quite substantially. N.E. Brown (1902) also revised the genus for tropical Africa allocating some 33 species to it. He produced the only thorough revision of the genus up until that time, and we agree with Kupicha (1984) who said of his work that it is '..... excellent with respect to species delimitation and accuracy of description.".

Bullock (1952) resurrected and lectotypified both *Aspidoglossum* and *Lagarinthus*. However, his work lacked circumscription for these genera and the species listed for each was incomplete. As a result, for many of his generic concepts it is difficult to know exactly what was intended by him.

Some 77 years after N.E. Brown's revision, Kupicha (1984) was the next to revise *Schizoglossum* in any depth or breadth. She reduced the genus to 12 species and confined it to southern Africa. She also continued to use *Aspidoglossum*, but redefined and expanded it to include the majority of southern African species previously placed in *Schizoglossum*. Seven species were also relocated, by her, to the newly described genus *Miraglossum*. Unfortunately, Kupicha was unable to complete he revision before her retirement from botany. As a result, no list of specimens consulted by her was ever published, although these specimens can be traced (via *determinavit* labels) in the many

herbaria from which she borrowed specimens. Also, a group of 48 names (12 from southern Africa) were left without generic status. Kupicha suggested that some of these belong to *Glossostelma* Decne., *Pachycarpus* E. Mey. (both tropical only) and *Stenostelma* Schltr. The remainder were left unplaced. Goyder (1998) has treated some of these when he revised *Pachycarpus*. Others have been placed in *Stenostelma* following Kupicha's suggestion, but only after careful reconsideration of characters and character patterns within the Asclepiadinae (Nicholas & Baijnath, in press). I have also examined most, but not all, of the residue of species and my findings will be discussed later. Recently, Hilliard (1988) has added two species to the genus *Schizoglossum* (*S. amatolicum* and *S. rubignosum*) and two to *Aspidoglossum* (*A. difficile* and *A. xanthosphaerum*).

TAXONOMY

Unfortunately, due to time and resource constraints, I have been unable to complete the revision of these genera to my satisfaction. As a result, the findings given here must be considered tentative. *Schizoglossum*, *Aspidoglossum* and *Miraglossum* will form the main focus of my research following this thesis; at which time I hope to resolve any problems not satisfactorily answered here. The findings given below are based on routine identification in these genera over the last 17 years, extensive field work, and the examination of all material at NH as well as some of the material at K and PRE. Amongst this material we have come across specimens that may represent new species and even one specimen (Smit 2669, PRE) which may represent a new genus allied to *Schizoglossum*.

Key to Genera

Because *Aspidonepsis* Nicholas & Goyder can be confused with *Aspidoglossum* and *Miraglossum* we have also included it in the key.

1a Corona-lobes cucullate, **with a sinus**, this sinus with or without a tongue-like or horn-like appendage ..... *Aspidonepsis*

1a Corona-lobes lamina-like or fleshy, usually with complex appendages from the inner or upper surface, rarely without, **without a sinus** 2

2a Inflorescences pedunculate ..... *Schizoglossum*

2b Inflorescences sessile 3

3a Corona-lobes fleshy, the lower half as broad as wide ..... *Miraglossum*

3b Corona-lobes lamina-like, dorso-ventrally flattened 4

4a Translator-arms attached to the middle of the inner margin of the pollinia ..... *Schizoglossum bidens* subsp. *pachyglossum*

4b Translator-arms attached apically to the pollinia ..... *Aspidoglossum*

SCHIZOGLOSSUM E. Mey., Comm. Pl. Afr. Austr.: 218 [1838]. **Type species:** *Schizoglossum atropurpureum* E. Mey. Lectotypified by Phillips (1951).

Description: Perennial geophytic herb; with milky latex. *Underground Organ* a small carrot-like stem-tuber which is usually solitary or occasionally complicated with fleshy branches. *Stems* erect, simple or occasionally branching, produced annually from the stem-tuber, usually hairy. *Leaves* shortly petiolate, spreading to spreading-erect, opposite & decussate or verticillate & irregular, simple, entire, linear to oblong to ovate, apex pointed, acute to obtuse, base tapering, round, truncate or hastate, margins revolute or flat. *Inflorescences* pedunculate, umbel-like, produced laterally at nodes near the apex & terminally, few-flowered. *Flowers* moderately sized. *Corolla* more or less lobed to the base; lobes reflexed, spreading or spreading-erect, elliptic to oblong, cucullate, margin flat & replicate. *Staminal corona* in 1-series, 5-merous; lobes, erect, dorso-ventrally flattened, alternating with the petals, almost always complicate or ornate, usually with an appendage on the inner face, rarely these absent; shorter than to greatly overtopping the

style-apex. *Anther-appendages* usually small, sometimes large, variously shaped, white, membranous, visible & pressed to the top of the style-apex or hidden below the style-apex. *Pollinia* pendulous & solitary in each anther sac, with a thin pellucid germination zone apically, translator-arms attached in the middle of the inner margin, connected laterally in pairs to a small or large and sometimes winged corpusculum. *Style-apex* flat, not exceeding the anthers. *Follicles* erect, solitary, small, usually fusiform, apex tapering into a narrow beak, usually covered in soft recurved bristles; pedicel recurved or once coiled in fruit (figs. 1 to 6). *Etymology*: From the Greek *schizo* (= cut or split) and *glossa* (= tongue); in reference to the fact the corona-lobe is often split into two parts (figs 1 to 5)

Discussion: A genus of 14 species, some of which are used for muthi. This genus is distinguished from *Aspidoglossum* by its pedunculate inflorescences (*S. bidens* E. Mey. subsp. *pachyglossum* (N.E. Br.) Kupicha the only exception), pollinia attached at their sides to the translator-arms and with a germination zone apically on the outer margin. It differs from *Miraglossum* by its less fleshy (not dorso-ventrally flattened) corona-lobes. Species are mainly found growing in annually burned or unburned grassveld.

Kupicha's circumscription of this genus is largely based on pollinarium structure, a difficult character to use and one which I don't find totally satisfactory. Nevertheless, the pattern she describes (pollinia attached to translator arms in the middle and pellucid germination zone on the outer upper margin) is definitely there; for most species. This kind of pollinarium is, in the Asclepiadinae, quite unique, although it is common in the tribe Stapelieae. It suggests that these species have a pollination syndrome similar to the stapeliads. The insertion of pollinia into the gynostegial-chamber is, in this type of pollinarium, apparently only partial rather than complete (Bruyns & Forster, 1991).

Kupicha (1984) believes this to be a model genus, however, my investigations suggest that it may be polyphyletic. *Schizoglossum flavum*, *S. hilliardae*, *S. quaridens*, *S. elingue* and *S. stenoglossum* seem more closely related to *Aidomene*, in particular subgenus *Callocymbion*, than to the rest of *Schizoglossum*. *S. elingue* (fig. 5) has a pollinarium that is more like *Aidomene*, although this cannot be said of the other species listed above. Also, the corona-lobes of some of these species are without appendages on the inner face, an odd situation in *Schizoglossum*. In fact, the corona-lobe structure in this

group of species can be easily derived from that of *Aidomene*. A specimen in NH (*Schelpe 950*) deted by Kupicha as *S. elingue* subsp. *elingue* is actually *Aidomene humilis*. This kind of mistake has happen to every taxonomist at one time or another (including the author), however, it does help to illustrates just how close these species are that they can be confused. Knowing how outstanding her revision was and just how thoroughly she worked, my finding that *Schizoglossum* may be polyphyletic is disturbing and one which I am reluctant at this stage to fully accept. Possibly *S. elingue* and allies represent the beginnings of *Schizoglossum*, and suggest that it arose from a common ancestor with *Aidomene*? However, this is not supported by the secondary metabolite profiles given in chapter 5. Much more work is required before a decision can be made on how to proceed. I also find Kupicha's species concept too broad, especially in *S. atropurpureum* and to a degree *S. bidens*. For *S. atropurpureum* she admits that the three subspecies can, arguably, be regarded as separate species. A comparison of her classification and the one suggested by my results so far are given in table 1.

Table 1. Comparison of the classification of *Schizoglossum* given by Kupicha with that suggested by my own data. Shaded species are those related *Aidomene* and may need at some latter date to be removed from *Schizoglossum*.

Kupicha 1984	Nicholas 1999
S. hamatum	*S. hamatum*
	S. amatolicum
	S. rubignosum
S. atropurpureum subsp. atropurpureum	*S. atropurpureum*
S. atropurpureum subsp. tridentatum	*S. tridentatum*
S. atropurpureum subsp. virens	*S. virens*
S. ingomense	*S. ingomense*
S. cordifolium	*S. cordifolium*
S. nitidum	*S. nitidum*
S. bidens subsp. hirtum	*S. hirtum*
S. bidens subsp. galpinii	*S. galpinii*

S. bidens subsp. productum	*S. productum*
S. bidens subsp. atrorubens	*S. atrorubens*
S. bidens subsp. pachyglossum	*S. pachyglossum*
S. bidens subsp. gracile	*S. gracile*
S. singulare	*S. singulare*
S. elingue subsp. *elingue*	*S. elingue* subsp. *elingue*
S. elingue subsp. *purpureum*	*S. elingue* subsp. *purpureum*
S. flavum	*S. flavum var. flavum*
	S. flavum var. lineare
S. hilliardae	*S. hilliardae*
S. stenoglossum subsp. stenoglossum	*S. stenoglossum subsp. stenoglossum*
S. stenoglossum subsp. latifolium	*S. stenoglossum subsp. latifolium*
S. stenoglossum subsp. flavum	*S. stenoglossum subsp. flavum*
Number of species = 12	Number of species = 19

Schizoglossum montanum R. A. Dyer probably belongs in *Schizoglossum*. Kupicha (1984) had excluded it, and suggested it was similar to, but different from, *Aspidoglossum*.

Distribution: Southern African endemic. Lesotho, South Africa [Northern, Gauteng, Mpumalanga, Free State, KwaZulu-Natal, Eastern Cape and Western Cape provinces] and Swaziland.

MIRAGLOSSUM Kupicha, Kew Bulletin. 38(4): 625 [1984]. **Type species:** *Miraglossum pulchellum* (Schltr.) Kupicha.

Description: Perennial geophytic herb; with milky latex. **Underground Organ** a small ovoid stem-tuber. *Stems* erect, simple, produced annually in spring from the stem-tuber, usually hairy. *Leaves* subsessile spreading-erect, simple, verticillate or irregularly inserted, sometimes opposite below the flowering section, entire, linear to narrowly triangular, margins revolute, usually hairy although occasionally glabrous. *Inflorescences* sessile, clustered & umbel-like, produced laterally at the nodes, few-flowered. *Flowers* moderate to small, but never cryptic. *Corolla* 5-merous more or less divided to the base, without a corolline corona; tube very small & saucer-like; lobes usually reflexed, elliptic.

Figure 1. *Schizoglossum atropurpureum* subsp. *atropurpureum*: a. Habitat showing whole plant (*circa* 1.2m tall), indicated with an arrow and; b. Close up of flowering stem. *S. hamatum*: c. Flowering stems and; d. Close up of flowers. Photographs: a by A. Nicholas; b by L. Greene; c by T. Abbott and; d by M. von Fintel.

Figure 2. *Schizoglossum bidens* subsp. *hirtum*: a. Whole plant showing habit (150mm) and, b. Whole plant showing carrot-shaped stem-tuber, indicated with an arrow. *Schizoglossum* subsp. *bidens*: c. Flowering stem. *S. bidens* subsp. *pachyglossum*: d. Whole plant showing habit & habitat (200mm tall); e. Close up of flowering stem and; f. Whole plant showing carrot-shaped stem-tuber, indicated with arrows. Photographs: a, b & d to f by A. Nicholas and; c by M. von Fintel.

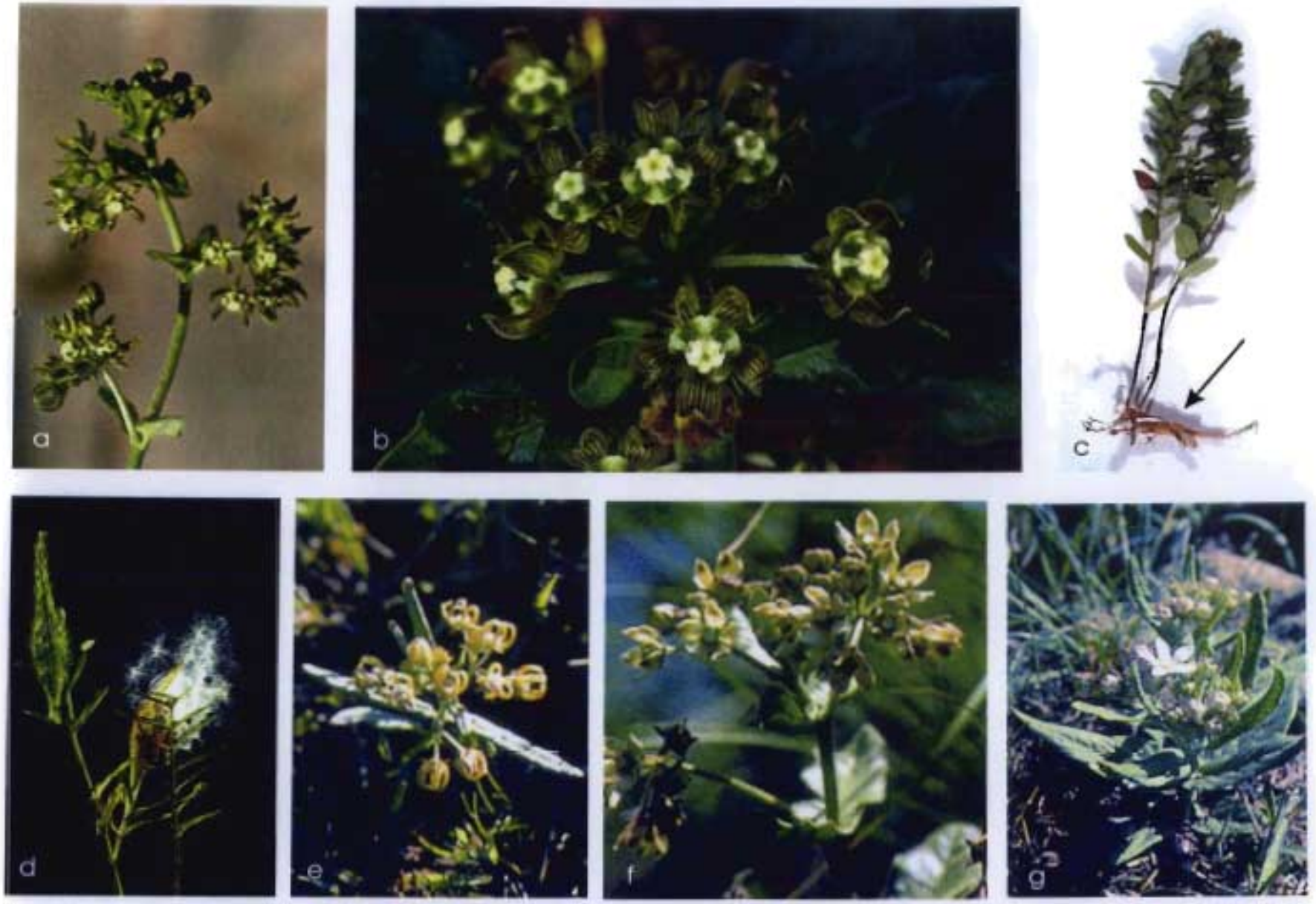

Figure 3. *Schizoglossum cordifolium*: a. Flowering stem; b. Close up of flowers from above; c. Whole plant showing stem-tuber, indicated with an arrow and; d. Follicle (typical of *Schizoglossum*) & seeds with coma of hairs. *S. nitidum*: e. Whole plant (*circa* 100mm tall). *S. hilliardiae*: f. Flowering stem. *S. quadridens*: g. Whole plant (*circa* 100mm tall). Photographs: a to d by A. Nicholas; e by R. Williams; f by M. von Fintel and; g by T. Abbott.

Figure 4. *Schizoglossum stenoglossum* subsp. *stenoglossum*: a. & b. Whole plant showing habit (200mm & 800mm respectively); c. Close up of flowering stem. *S. stenoglossum* subsp. *flavum*: d. Flowering stem. *S. flavum*: e. Whole plant (100mm tall) and; f. Close up of flowers. Photographs: a, b, e & f by A. Nicholas; c by M. von Fintel and; d. by P. Cooke.

Figure 5. *Schizoglossum elingue*: a. Whole plant showing habit (100mm tall) and; b. Close up of flowers. c. Coleford Nature Reserve in the Natal Midlands. These annually burned grasslands are rich in Ascelpiadaceae, amongst other species. The senior author has collected *Schizoglossum bidens* subsp. *hirtum* at this reserve. Photographs: a by T. Coleman and; b & c by A. Nicholas.

Staminal corona in 1-series, consisting of 5 fleshy, thick lobes which alternate with the petals, usually highly ornate, variously divided & with long or short appendages, simple in one species only. *Anther-appendages* small, white, membranous. *Pollinia* solitary & pendulous in each anther-sac, sausage-shaped, without a clearly defined pellucid germination zone, translator-arms wide, attached apically or just below the apex on the inner margin to the pollinia; corpuscula large and arrow-shaped. *Style-apex* flat with margins thickened & undulate, never exceeding the anthers. *Follicles* solitary, erect, fusiform, echinate with soft recurved bristles or covered in a thick down of hairs; pedicels recurved or coiled in fruit (fig. 7). *Etymology:* From the Greek *mira* (= astonishing or miraculous) and *glossa* (= tongue); in reference to the highly ornate or 'astonishing' corona-lobes of some species (fig. 7)

Discussion: This genus was recently split off from *Schizoglossum* (Kupicha, 1984). It resembles *Schizoglossum* and *Aspidoglossum*, being phylogenetically related to the latter rather than the former. *Miraglossum* differs from *Schizoglossum* in its sessile inflorescences, corolla reflexed and usually densely hairy, and absence of a defined germination zone on the pollinia. We agree with Kupicha that *Miraglossum* and *Aspidoglossum* together form a monophyletic group. Cladists would sink the two because of this. However, I am quite happy to threat these as a paraphyletic or holophyletic group. To sink *Miraglossum* into *Aspidoglossum* would mean that this very distinct group of species would lose any indication of their unique relationship to each other. *Miraglossum* is most close to *Aspidoglossum* section *Verticillus*. It can be distinguished from *Aspidoglossum* by its thick fleshy (not dorso-ventrally flattened) corona-lobes. Some convergence of floral characters has occurred between the two genera with *M. pulchellum* (Schltr.) Kupicha and *A. dissimile* (N.E. Br.) Kupicha looking similar, however, this is not due to common descent. Species occur mainly in annually burnt midland or upland grassveld. I find this to be a well-defined genus, consisting of seven species (table 2).

Table 2. Species belonging to the genus *Miraglossum*

Miraglossum
M. pullchellum
M. anomalum
M. laeve
M. verticillare
M. pilosum
M. superbum
M. davyi
Number species = 7

Distribution: Southern African endemic. Lesotho, South Africa [Northern, Gauteng, Mpumalanga, Free State, KwaZulu-Natal and Eastern Cape provinces] and Swaziland.

ASPIDOGLOSSUM E. Mey., Comm. Pl. Afr. Austr.: 200 [1838]. **Type species:** *Aspidoglossum biflorum* E. Mey. Lectotypified by Bullock (1952).

Description: Perennial geophytic herbs; with milky latex. *Underground organ* a napiform stem-tuber. *Stems* long, erect, produced annually in spring from the stem-tuber, simple or branched & often grass-like in appearance. *Leaves* sessile or shortly petiolate, spreading or erect, usually opposite, occasionally verticillate or irregular, simple, narrowly linear, rarely elliptic, margins entire & revolute. *Inflorescences* sessile, umbel-like, clustered & lateral at the upper nodes, few-flowered. *Flowers* usually small & cryptic, rarely large. *Corolla* 5-merous, campanulate, cupular or rotate, divided more or less to the base, glabrous or hairy; tube very short & saucer-like; lobes spreading or spreading-erect, rarely reflexed, in one species connivent & fused at the tips to form a cage over the tube mouth, elliptic, margins flat or replicate. *Staminal corona* in 1-series, consisting of 5 thinly textured, dorso-ventrally flattened, erect lobes that alternate with the petals, square in dorsal view with upper surface emarginate or appendaged, shorter than or resting on the style-apex. *Anther-appendages* small, white & membranous. *Pollinia* solitary & pendulous in each anther-sac, attached apically or subapically to the translators at the pellucid germination zone & connected in pairs via a small

Figure 7. *Miraglossum pilosum*: a. & b. Flowering stems. *M. verticillare*: c. Flowering stem. *M. pulchellum*: d. Flowering stem; e. & f. Close up of flowers. *M. superbum*: g. Close up of flower. Photographs: a, d & e by A. Nicholas; b by L. Greene; c. & f by M. von Fintel and; g. by Anonymous.

corpusculum. *Style-apex* flat & not exceeding the anthers. *Follicles* solitary, erect, fusiform, smooth or with long soft recurved bristles; pedicels recurved in fruits (fig 8 & 9). *Etymology*: From the Greek *aspido* (= shield) & *glossa* (= tongue); in reference to the square, shield-like corona-lobes.

Discussion: This is a large genus which also extends into tropical Africa. It differs from *Schizoglossum* in its sessile clustered inflorescences and pollinia with apically or subapically attached translators. From *Miraglossum* it differs in its non-fleshy corona-lobes, and from *Aspidonepsis* by its dorso-ventrally flattened corona which lacks a central sinus with or without a horn-like appendage. Plants are found growing in annually burnt grassveld or in savannas, and occur at a wide range of altitudes. Using leaf, corona, pollinaria and fruit structure, this genus was divided into four sections by Kupicha (1984): viz. *Aspidoglossum*, *Verticillus*, *Virga* and *Latibrachium*. It contains 35 species, 23 in southern Africa (table 3). *A. delagoense* (Schltr.) Kupicha has been transferred to *Aspidonepsis* Nicholas & Goyder (Nicholas *et al.*, in press)

Table 3. Southern African species belonging to the genus *Aspidoglossum*

Section	*Aspidoglossum*
Aspidoglossum	*A. biflorum* *A. carinatum* *A. virgatum* *A. uncinatum* *A. demissum* *A. fasciculare*
Verticillus	*A. heterophyllum* *A. dissimile* *A. grandiflorum* *A. ovalifolium* *A. validum*
Virga	*A. woodii* *A. flanaganii* *A. gracile* *A. masaicum* *A. interruptum*
Latibrachium	*A. glabrescens* *A. araneiferum* *A. glanduliferum*

	A. lamellatum *A. xanthosphaerum* *A. restioides*
	Number of species = 21

Schizoglossum peglerae N.E. Br. probably belongs in *Aspidoglossum*. Kupicha (1984) excluded it, but did remark on what she believed was some superficial resemblance. In 1988, Hilliard described *A. difficile* from a specimen [*Pooley 1921*] collected at St. Lucia. I have seen both the holotype (at K) and isotype (at NU) and it does not belong in *Aspidoglossum*. In this we agree with Kupicha who deted the specimen as being neither *Schizoglossum* or *Aspidoglossum*. However, like her, I am, at this stage, unsure where it should be placed.

Distribution: African endemic. Botswana, Lesotho, South Africa [all provinces] and Swaziland. Also in tropical Africa.

Species transferred to *Stenostelma*

A number of species have been transferred to *Stenostelma* as outlined in table 4.

Table 4. Species transferred to *Stenostelma* (Nicholas & Baijnath, in press)

Schizoglossum	***Stenostelma***
S. capense = *S. aciculare* =	*S. capense*
S. corniculatum =	*S. corniculatum*
S. periglossoides = *S. orbiculare* =	*S. periglossoides*
	S. carinatum
S. umbelluliferm =	*S. involucratum*
	S. zeyheri
	Stenostelma sp. nov. a
	Stenostelma sp. nov. b
	Number of species = 8

Figure 8. *Aspidoglossum glanduliferum*: a. Flowering stems; b. Close up of flowers; c. Whole plant (600mm tall) showing globose stem-tubers, indicated with an arrow and; d. Close up of stem-tuber showing root system with what may be nitrogen fixing nodules. *A. fasiculare*: e. Flowering stem. Photographs by A. Nicholas.

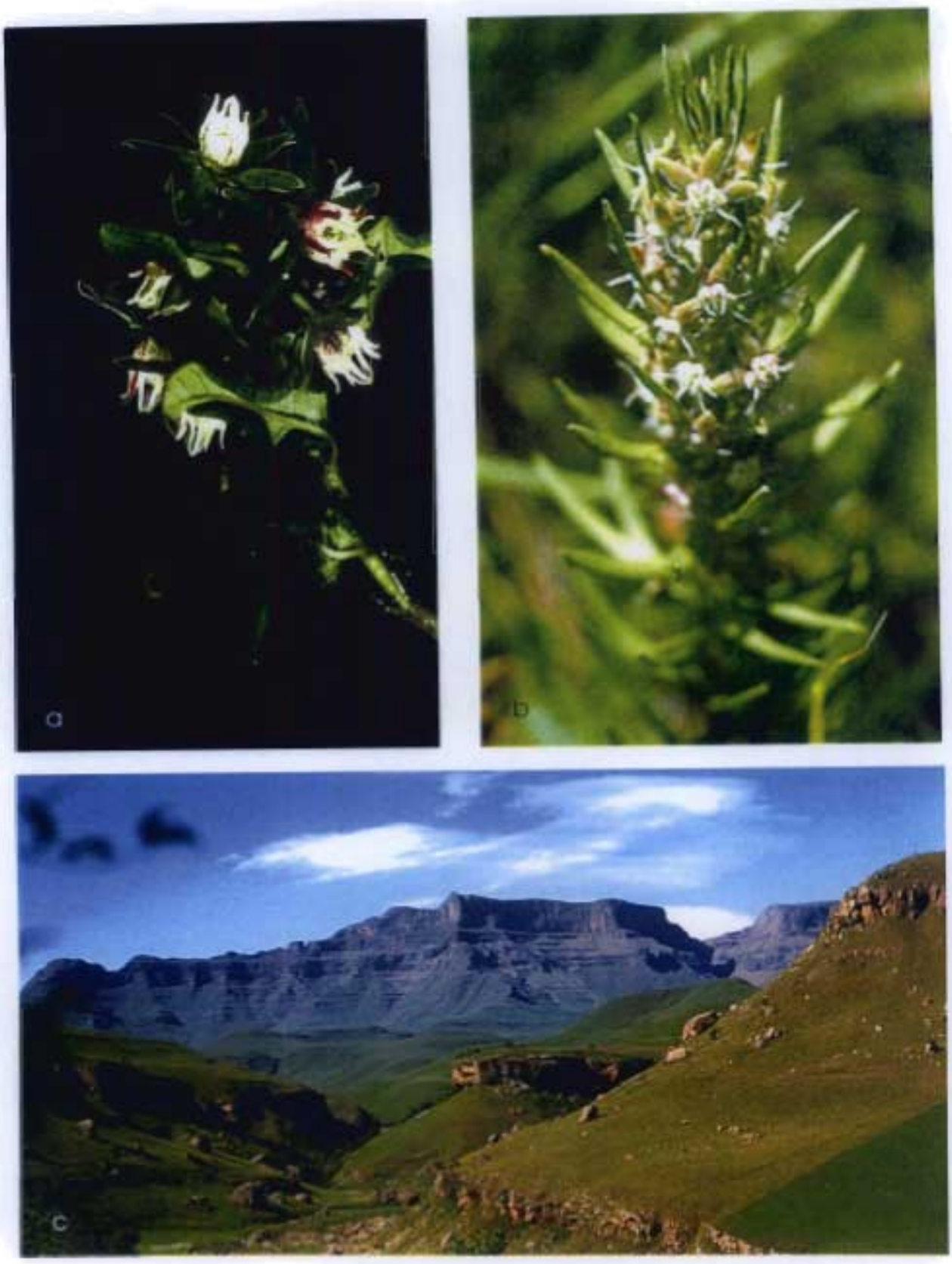

Figure 9. *Aspidoglossum ovalifolium*: a. & b. Flowering stem. c. Natal Drakensberg the natural habitat of many *Schizoglossum, Miraglossum & Aspidoglossum* species, note the fire break in the bottom right hand corner, these have become havens for many asclepiads that require regular fires for survival. Photographs: a & c by A. Nicholas and; b by G. Nichols.

Kupicha (1984) suggested that *S. crassipes* (Schltr.) Huber and *S. eustegioides* (E. Mey.) Druce should be included in *Stenostelma*. These two taxa appear to be conspecific, however, they lack the barrel-shaped gynostegial-column and anther-wings with a notch in its length at about the middle; which are characteristic of all *Stenostelma* species. Also, the corona-lobes are spathulate rather than tear-drop shaped or ovate as is common in this genus. I am still unsure where these species should be placed; further investigation is required.

Unplaced Species

Schizoglossum linifolium Schltr. (including *S. pygmaeum* Schltr.) may have to be placed in a genus of its own (fig. 6). As the name is conspecific with the type name of the genus *Lagarinthus* (viz. *L. tenuis* E. Mey.) this name will be resurrected this genus. *S. aschersonianum* (including *S. tenellum* (Turcz.) Druce) may also belong here (fig. 7).

Schizoglossum garcianum has a vegetative facie that resembles that of genera *Stenostelma* and *Bruynsia*, however, the floral structure, especially gynostegium and corona, are quite different. I am, at present, still not sure of where it should be placed; more work is required.

Schizoglossum pedunculatum Schltr., is a synonym of *Aidomene aureus* (Schltr.) Nicholas & Goyder and *S. capitatum* Schltr. is *Bruynsia capitata* (Schltr.) Nicholas (Nicholas *et al.*, in press).

Other names listed by Kupicha are either not southern African (so have not been considered here) or have already been reduced to synonymy under other genera by N.E. Brown (1907).

Conclusion

A great deal more work needs to be done on the species of the genera outlined in this chapter. This will form the basis of the work on which I intend to concentrate following this thesis. Without doubt these genera are taxonomically the most difficult in the subtribe Asclepiadinae.

Figure 6. *Schizoglossum linifolium*: a. Whole plant showing habit & habitat (1 meter tall); b. Close up of flowering stem; c. Follicles and; d. Whole plant showing carrot-shaped stem-tuber, indicated with an arrow. Photographs by A. Nicholas.

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CHAPTER 4.5

EXCLUDED GENERA

These are genera that were once placed in the subtribe Asclepiadinae, but are here revised then removed to other subtribes within the Asclepiadeae. The decision to remove these from the subtribe was largely based on data collected from herbarium specimens. This is true for most of the data used in this thesis. Specimens in herbaria play a central and pivotal role in taxonomy.

"Systematics and taxonomy are essential: they respectively elucidate life's history, and organize and verify biological knowledge. This knowledge is built of interrelated concepts which are ultimately accounted for by biological specimens." "The preservation of specimens in natural history collections is the essential part of the process which builds and maintains biological knowledge."

— Cotterill, 1995* .

CONTENTS

* COTTERILL, F.P.D. 1995. Systematics, biological knowledge and environmental conservation. **Biodiversity and Conservation.** 4: 183—205.

Chapter 6.4.1

Taxonomic Revision of the genus *Pentarrhinum* Decne. (Apocynaceae: Asclepiadoideae)

"In order to remember, understand, and interpret what we see, our minds constantly seek patterns, not just in the diversity among angiosperms, but in everything that we consider"
Cronquist 1988

Pentarrhinum insipidum Decne. Photo. by G. Nichols

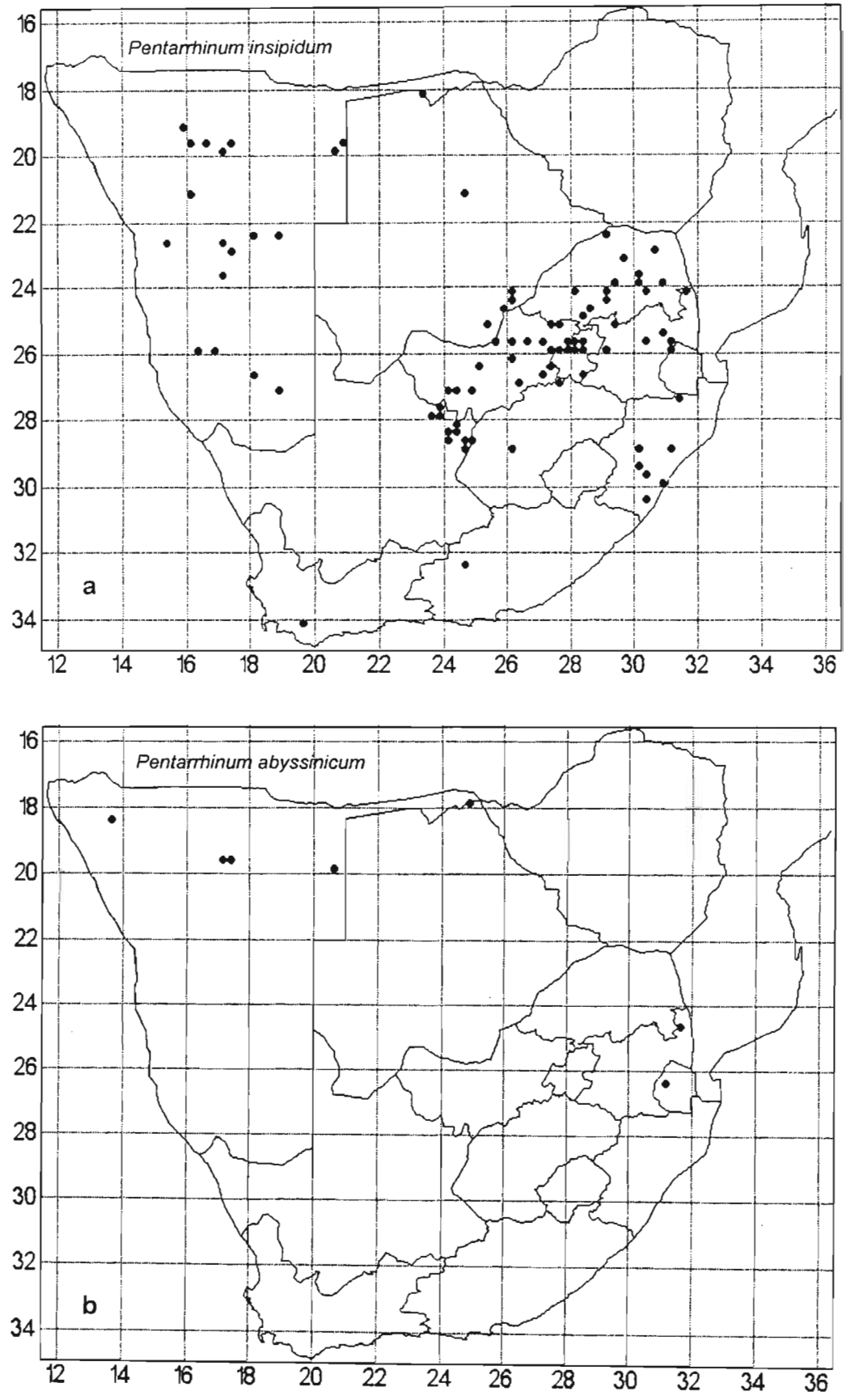

Figure 1. Distribution maps of: a. *Pentarrhinum insipidum* and; b. *P. abyssinicum*.

A revision of the genus *Pentarrhinum* E. Meyer (*Asclepiadaceae*)

SIGRID LIEDE* & ASHLEY NICHOLAS**

Summary. The genus *Pentarrhinum* is revised. Of the six species described, only two (*P. abyssinicum* and *P. insipidum*) are maintained in the genus. Relationships and distributional patterns are discussed.

INTRODUCTION

Members of the genus *Pentarrhinum* have been known as early as 1738, when Burmann depicted *P. insipidum* as "*Cynanchum foliis cordatio-sagittatis, fructu cucumerino*". However, it was Meyer (1837) who first recognized the distinct nature of *P. insipidum* and founded a separate genus for it.

Although in de-limiting his new genus he compared it with *Asclepias*, he failed to do so against *Cynanchum*, nor did he mention the close relationship of the latter genus to *Pentarrhinum*. Subsequently, five species were added to *Pentarrhinum*, but only N. E. Brown (1908) attempted a more concise circumscription of the genus.

The affinities of *Pentarrhinum* have so far received little attention. In major classifications of the *Asclepiadaceae* the genus is regularly found amongst the many relations of *Asclepias* L. Decaisne (1844) placed it in "Divisio VII: Asclepiadeae" next to *Schizoglossum* E. Meyer. Bentham & Hooker (1876) placed it in the tribe *Cynancheae* between *Raphistemma* Wallich and *Pycnostelma* Bunge ex Decne. Schumann (1895) followed Bentham and Hooker and placed the taxon in the "*Asclepiadeae–Asclepiadinae*" between *Raphistemma* and *Strobopetalum* N. E. Br. N. E. Brown treated the genus inconsistently; in the "Flora of Tropical Africa" (1902–1903) he placed it between *Pachycarpus* E. Meyer and *Pentatropis* R. Br., while it is found between *Oncinema* Wight (= *Glossostephanus* E. Meyer) and *Cynanchum* L. in "Flora Capensis" (1908).

MATERIAL AND METHODS

This study is based on material of *Pentarrhinum* housed at BM, BOL, K, MO, NBG, PRE, SAM and STEU, and a living specimen of *P. insipidum* (*Liede & Meve* 584), raised from seeds collected in Namibia and growing at MO.

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* Institute für Botanik, Schlossgarten 3, D-4400 Münster, Germany. Present address: Abtlg. Spez. Botanik (Bio V), Albert-Einstein-Allee II, W7900 Ulm, Germany.

** National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa.

POSITION OF THE GENUS IN THE TRIBE *Asclepiadeae*

Despite long-standing criticisms (e.g. Woodson 1941) which are based on some apparent inconsistencies, the tribal classification of the *Asclepiadaceae* outlined by Schumann (1895) has not yet been replaced by a system better representing the relationships between the genera in this complex family. From his delimitation of tribes it is apparent that *Pentarrhinum* belongs in the tribe *Asclepiadeae* which is characterized by pendulous pollinia.

Schumann (1895) divided the *Asclepiadeae* into five subtribes, a point which has raised some criticism (e.g. Rosatti 1989). For a number of reasons, however, a tribe as large as the *Asclepiadeae* is in need of division into smaller units. While the present state of knowledge does not allow a complete revision of Schumann's concept and a circumscription of subtribes corresponding to a set of synapomorphies, it seems adequate to adjust his circumscription according to new evidence.

Schumann placed the genus *Pentarrhinum* in the subtribe *Asclepiadinae*, which united genera with a valvate aestivation and free or nearly free corona segments. More than anything else, the corona structure of *P. insipidum*, which superficially resembles the horn of *Asclepias*, might have influenced his judgement. However, *P. abyssinicum* does not display this structure, suggesting its independent development in *P. insipidum*. Thus the corona structure cannot be used as a synapomorphy in this case. Other characters, such as the elongate botryoid inflorescence, the rather smaller flowers, the nearly free petals and the shape of the pollinaria point to a close relation to the genus *Cynanchum* and thus the subtribe *Cynanchinae*, and not to the subtribe *Asclepiadinae*. The characters defining the subtribe *Cynanchinae* are an imbricate or contorted aestivation and an — at least partial — fusion of staminal and interstaminal corona parts. These character states do not exclude *Pentarrhinum*. We therefore propose that *Pentarrhinum* be transferred to the subtribe *Cynanchinae*.

The subtribe *Cynanchinae* consists of ca. 40 genera, most of them comprising only a few species, *Sarcostemma* R. Br. sensu Holm and *Cynanchum* being the exceptions. *Cynanchum*, in its present circumscription, constitutes a heterogeneous alliance of some 200 species, united by the possession of a gynostegial corona with fused staminal and interstaminal parts, small flowers and slender follicles. However, conclusive data as to the monophyly of this taxon are so far lacking.

Within *Cynanchum*, a shrubby twining habit, an elongate botryoid inflorescence and a little-differentiated corona with prominent staminal parts can be regarded as primitive (Liede unpubl.). *C. somaliense* exhibits these primitive character states. These characters are also shared by *Pentarrhinum*, suggesting a common ancestor for *Pentarrhinum* and *C. somaliense* — and thus at least a part of the genus *Cynanchum*. While *Pentarrhinum* is well defined by the synapomorphies of a slipper-shaped corona (Fig. 1) and follicles with protuberances, a synapomorphy supporting the relationship between *Pentarrhinum* and *Cynanchum* could not be found. For theoretical reasons, however, synapomorphies in a primitive alliance cannot be as apparent as in derived groups of species. Therefore, following the concept of overall similarity, a derivation of *Pentarrhinum* and *Cynanchum* from a common ancestor seems to be the most probable hypothesis.

Accepting this hypothesis, within *Pentarrhinum*, *P. insipidum* is clearly the more

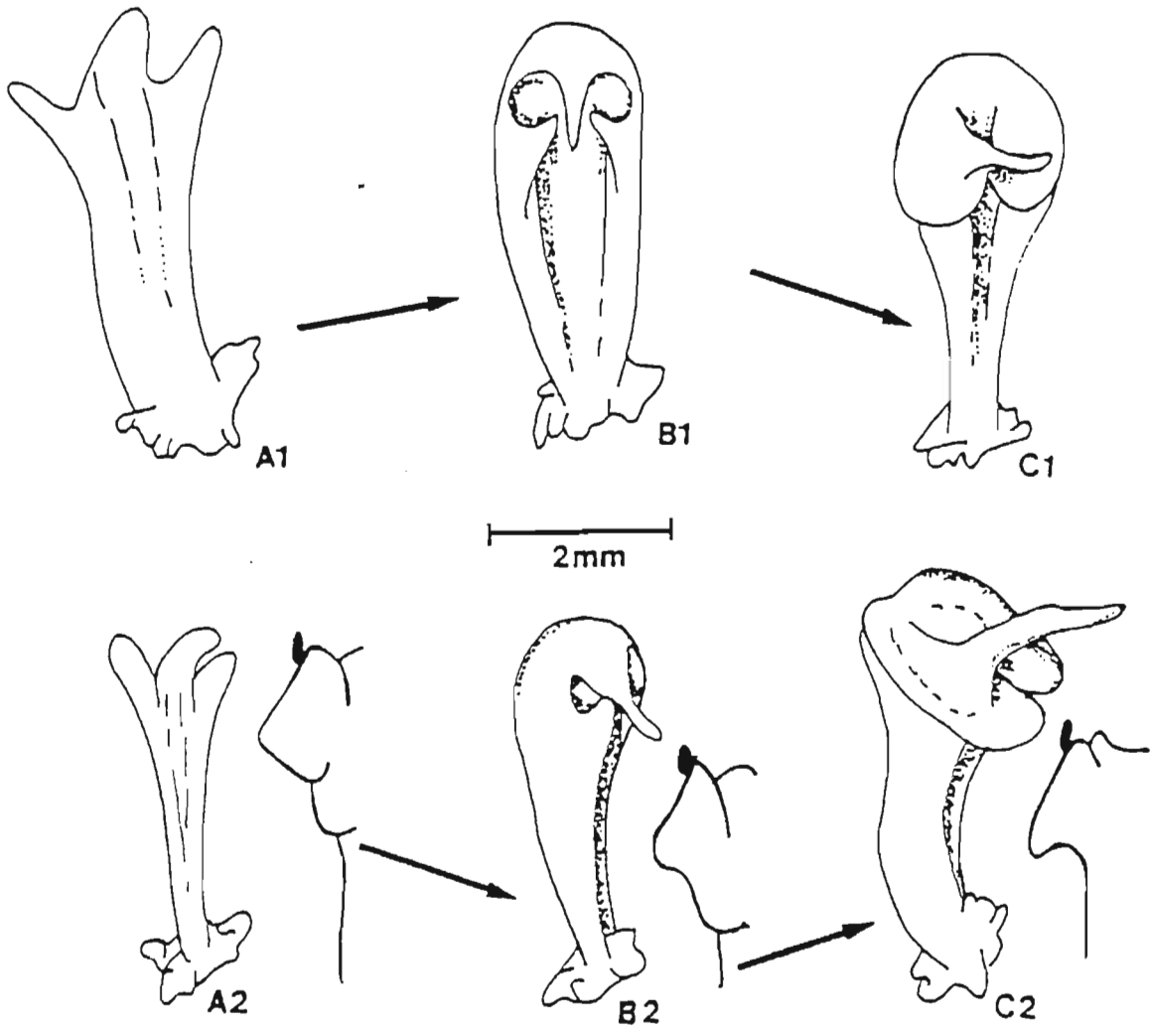


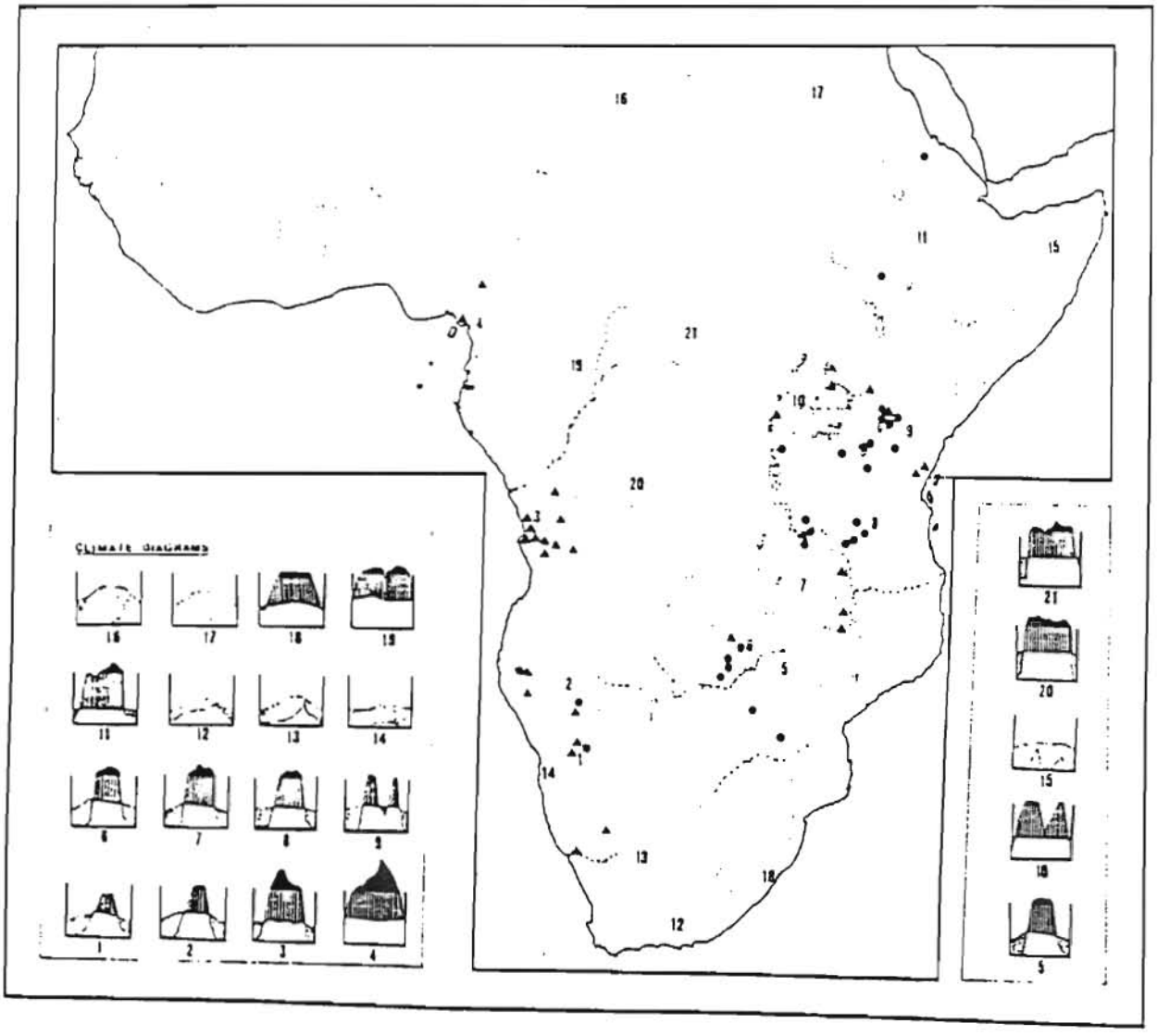
FIG. 1. Corona lobe structure showing the probable evolutionary sequence of this structure in *Pentarrhinum insipidum* from a *Cynanchum somaliense*-like ancestor. A corona lobe of *Cynanchum somaliense* (*Mesfin & Vollesen* 4238 (K)); B corona lobe of *P. abyssinicum* (*Richards* 23159 (K)); C *P. insipidum* (*Richards* 23611 (K)). 1 oblique front view; 2 oblique side view. Drawn by A. Nicholas.

advanced species due to its fleshy, papillose, peltate corona and the horn-like process emerging from each corona lobe.

PHYTOGEOGRAPHICAL AND ECOLOGICAL OBSERVATIONS

The genus *Pentarrhinum* is virtually restricted to the Sudano-Zambesian region as defined by White (1965; Map 1 & 2). Both species seem to be associated with shrublands and savanna, in dry or well drained situations. However, they seem unable to tolerate extremes of wet or dry, as they skirt both the Congo basin and the Horn of Africa. Neither are they found in the winter rainfall area of South Africa and Namibia nor in the small zone of year-round rainfall along the southern Cape coast. The areas of the two species overlap considerably (Map 1 & 2), but show some interesting differences. Present day distribution must be interpreted as reflecting both the ecological tolerances of the plants and the fluctuating climatic past of the African continent.

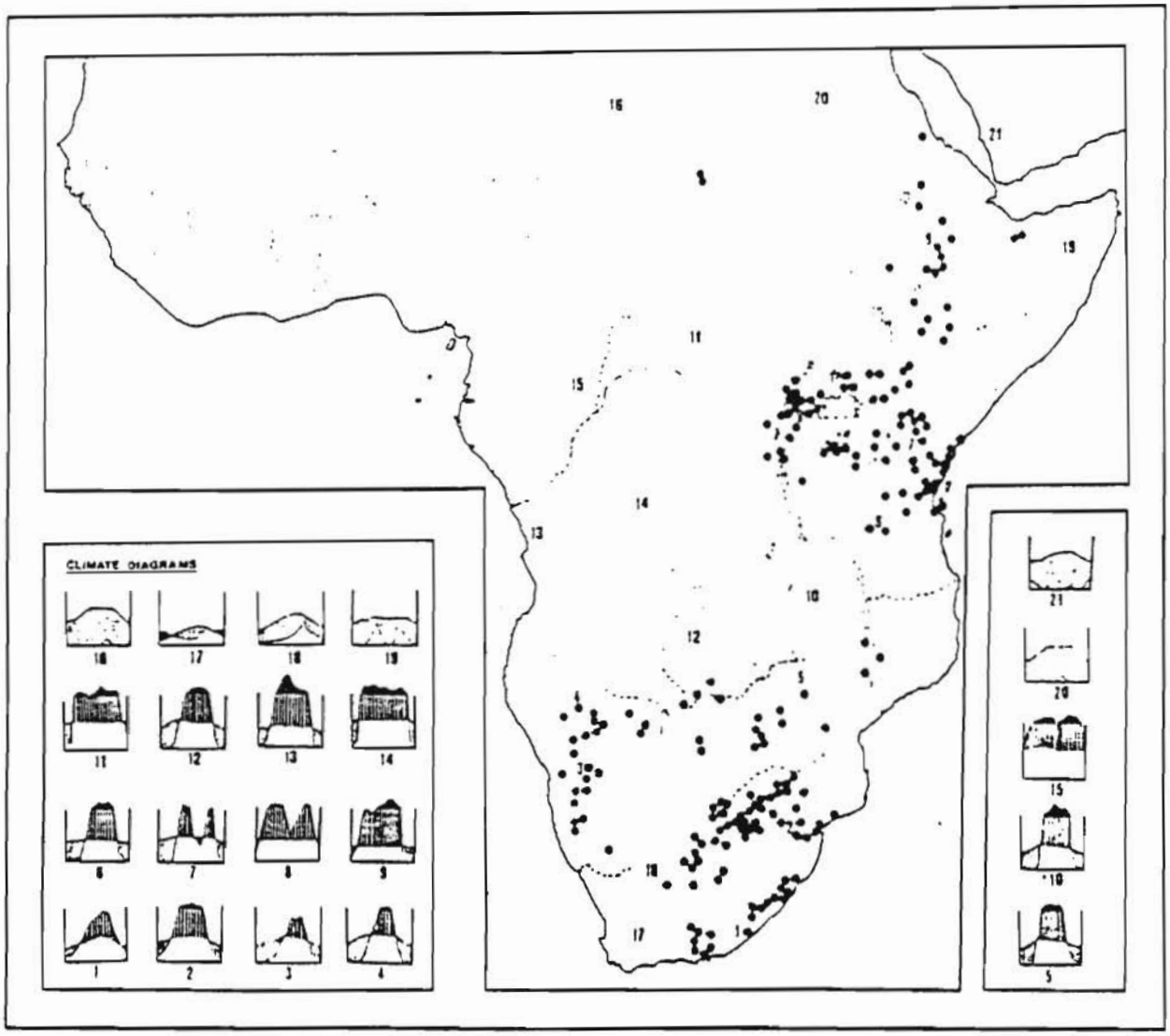
P. abyssinicum (Map 1) has a wider, but much more scattered, distribution than *P. insipidum* (Map 2). Its occurrence in the mountains of Cameroon is at first striking, but supports White's (1981) suggestion that "communication southward by way of the country highlands of Angola" must not be ruled out for these West African mountains. Other examples (e.g. *Podocarpus latifolius* (Thunb.) R. Br. and *Ocotea gabonensis* Fouilloy) are known to show this distributional pattern. *P. abyssinicum* is completely absent from South Africa and Botswana. While the two subspecies occur sympatrically in East Africa and as far west as northern Namibia, only ssp. *abyssinicum* extends north into Ethiopia. Along the West coast, ssp. *angolense* is the only representative of the species (Map 1). Both prefer altitudes between 1000 m and 2000 m, with ssp. *angolense* preferring slightly



Map 1. Distribution of *P. abyssinicum* ssp. *abyssinicum* (●) and ssp. *angolense* (▲). Climatic diagrams: 1 Windhoek, 2 Ondangue, 3 Bela Vista, 4 Douala, 5 Sipolilo, 6 Lusaka, 7 Mpika, 8 Iringa, 9 Makindu, 10 Mbarara & 11 Addis Abeba are adapted from towns within the distribution range of this species. Climatic diagrams: 12 Jansenville, 13 Upington, 14 Swakopmund, 15 Las Anod, 16 Faya Largeau & 17 Merowe are from towns in arid regions outside the distribution range. Climatic diagrams: 18 Durban, 19 Ouesso, 20 Tshikapa & 21 Bondo are from towns in wet areas outside the distribution range. In the northern hemisphere the horizontal axis runs from July to June, while in the southern hemisphere this axis runs from January to December. The warmest part of the year will therefore always fall in the middle of the diagram. (See Walter *et al.* 1975.)

higher altitudes. In their overlapping area, the two subspecies differ in their ecological preferences. While *P. abyssinicum* ssp. *abyssinicum* tends to be associated with grasslands or open woodland, *P. abyssinicum* ssp. *angolense* is always associated with forest or thicket margins.

The distribution of *P. insipidum* (Map 2) shows a slightly different pattern. It does not share the disjunctions of *P. abyssinicum* in the Angolan and the Cameroon mountains, but has two other interesting disjunctions in its distribution. It is widespread in South Africa and Namibia, and again in the Northern Tanzania/Kenya area, from where it extends into Ethiopia. It has, however, not yet been found in northern Zambia or northern Malawi. More interesting is its isolated station on Jebel Marra in Sudan, more than a thousand kilometres from the nearest population in Ethiopia, which is most probably a relict from moister



Map 2. Distribution of *P. insipidum*. Climatic diagrams: 1 Queenstown, 2 Barberton, 3 Windhoek, 4 Ondangua, 5 Sipolilo, 6 Iringa, 7 Makindu, 8 Mbarara & 9 Addis Abeba are adapted from towns within the distribution range of this species. Climatic diagrams: 10 Mpika, 11 Bondo, 12 Mongue, 13 Bela Vista & 14 Tshikapa are from towns in wet areas outside the distribution range. Climatic diagrams: 15 Quesso, 16 Faya Largeau, 17 Sutherland, 18 Upington, 19 Las Anod, 20 Merowe & 21 Kamaran are from towns in arid areas outside the distribution range. In the northern hemisphere the horizontal axis runs from July to June, while in the southern hemisphere this axis runs from January to December. The warmest part of the year will therefore always fall in the middle of the diagram. (See Walter *et al.* 1975.)

periods. The occurrence of this species as far north as Jebel Marra makes its absence from the Arabian Peninsula even more striking, and awaits explanation. Ranging from sea level to 2200 m, it has also been reported in low-lying areas from which *P. abyssinicum* is absent. Most collections originate from altitudes between 600 m and 1600 m.

Infraspecific variation in floral structure in *P. insipidum* is low over its whole distribution range. Minor variations occur in floral size and colour. The two subspecies of *P. abyssinicum* also show little infrasubspecific floral variation. A wider range of variation has been found in leaf size, but not in leaf shape. In both species, however, populations differ widely in the ornamentation of the fruits. All degrees between slightly echinate and a dense cover of long protuberances have been recorded.

Taxonomy

Pentarrhinum *E. Meyer* in Comm. Pl. Afr. Austr.: 199–200 (1837); Decne, in DC., Prodr. 8: 553 (1844); Benth. & Hook. f., Gen. Pl. 2, 2: 758–759 (1876); Schum., in Engl. & Prantl, Nat. Pflanzenfam. 4, 2: 244 (1895); Schum., in Engl., Pflanzenw. Ost-Afrikas. Theil C: 323 (1895); N. E. Br. in Thiselton-Dyer, Fl. Trop. Afr. 4, 1: 378 (1902); N. E. Br., in Thiselton-Dyer, Fl. Cap. 4, 1: 741 (1908); Huber in Merxmüller, Prodr. Fl. Südwest-Afrika 114: 47 (1967); R. A. Dyer, Gen. S. Afr. Fl. Pl. 1: 483–484 (1975); Malaisse, Fl. Rwanda 3: 106–108 (1985). Type species: *Pentarrhinum insipidum* E. Meyer.

Twining herbs with slender stems. Rootstock perennial, shoots annual. Leaves herbaceous, petiolate, cordiform. Colleters conspicuous in the leaf-stem cleft. Inflorescence 5–15-flowered, cymose, extra-axilliary, pedunculate. Floral bracts minute. Petals fused at the base, ovate, strongly decurved. Corona gynostegial, consisting of connate staminal and interstaminal parts, arising at the base of the gynostegium. Staminal parts laterally conduplicate, apically either conduplicate or provided with a horn-like ornament projecting towards the gynostegium. Interstaminal parts short, undifferentiated. Gynostegium sessile. Anthers with vaguely differentiated wings and broadly ovate, inflexed appendages. Pollinaria pendulous, translator arms planar, triangular, laterally inserted at the elliptic pollinia. Style apex flat. Fruits mostly solitary, ellipsoid, round in cross section, apically beaked. Surface with protuberances of variable length and density. Seeds ovate, papillate or with trichomes, winged or wingless, comose.

Distribution. Africa.

Key to species and subspecies of *Pentarrhinum*

1. Corolla greenish-yellow, often with a strong reddish-brown tinge; corolla lobes ciliate; corona as high as the gynostegium; corona lobes fleshy, papillose; lateral parts of the corona lobes reduced, conduplicate, apical part cucullate, resulting in a horn-like structure projecting from the centre of the lobe towards the gynostegium and partly over it..... **P.insipidum**

Corolla greenish; corolla lobes smooth, or ciliate; corona nearly twice as high

as the gynostegium; corona lobes thin, laterally and apically conduplicate, resulting in a slipper-shaped form; not papillose; the tip of the slipper pointing towards the gynostegium, but not projecting over it.....2

2. Flowers less than 10 mm diam.; corolla lobes fully reflexed at anthesis, smooth; plants associated with grasslands and open woodlands..... **P.abyssinicum** ssp. **abyssinicum**

Flowers more than 10 mm diam.; corolla lobes not fully reflexed at anthesis, ciliate (very rarely smooth); plants associated with forest margins and thickets..... **P.abyssinicum** ssp. **angolense**

Enumeration of species

Pentarrhinum abyssinicum Decne., in DC. Prodr. 8: 553 (1844); Schum., in Engl. & Prantl, Nat. Pflanzenfam. 4, 2: 244 (1895); Schum., in Engl. Pflanzenw. Ost-Afrikas. Theil C: 323 (1895); N. E. Br., in Thiselton-Dyer. Fl. Trop. Afr. 4, 1: 378–379 (1902); Huber, in Merxmüller, Prodr. Fl. Südwestafrika 114: 47 (1967). Typus: De Lessert, Icones selectae, vol. 5, Tab. 80, 1846 (lectotype designated here).

a. ssp. **abyssinicum**

Plants herbaceous, richly branched, twining; shoots annual, 200–250 cm long, 1–2 mm diam., glabrous to pubescent; trichomes 0·3–0·4 mm long, multicellular, appressed. *Roots* fibrous. *Leaves*: Blades cordiform, 35–70 mm long, 20–50 mm wide; base cordate to lobate; apex acute to acuminate, 1–9 mm long; adaxial surface glabrous to pubescent; trichomes concentrated along the veins, 0·4 mm long, multicellular; abaxial surface pubescent, trichomes concentrated along the veins, 0·3–0·4 mm long, multicellular, erect; petiole 15–35 mm long; 4–5 colleters at the base of the leaf. *Inflorescence* cymose, botryoid, 5–15-flowered; peduncles 15–45 mm long, indumentum unifarious, rachis 0·5–20 mm long, straight. *Flowers*: Bracts 1·2 × 0·4 mm, triangular, with hairs; pedicel 5–25 mm long, indumentum unifarious; buds globular, 3–5 mm long, 3–5 mm diam. petals imbricate, dextrorse. *Calyx* rotate; sepals ovate, 1·5–2·5 × 0·5–1 mm, apex acute, base connate, abaxial surface pubescent and ciliate. *Corolla*: lobes ovate, 4–5 × 3 mm, fully reflexed at anthesis, greenish-yellow, glabrous, apex acute, base connate. *Corona* 2–3 mm high, taller than the gynostegium, glabrous; staminal and interstaminal parts basally connate; staminal parts laterally and apically conduplicate, resulting in slipper-shaped lobes. *Gynostegium* sessile, 0·8 mm high, 1·6 mm diam. *Anthers*: Connective appendages widely ovate 0·25 × 0·5 mm, inflexed; anther wings 0·5 mm long, straight, parallel, double, inside bristly. *Pollinarium*: Corpusculum 0·25 mm long; translator arms 0·25 mm long, planar, triangular; pollinia elliptic, 0·45 × 0·2 mm (Fig. 4a). *Gynoecium*: Style apex 0·2 mm high, 1 mm diam., flat. *Fruit*: Follicles one, rarely two per flower, containing approx. 40 seeds each, 70 × 15 mm, ellipsoid, round in cross section, apically long-beaked, light brown, glabrous but densely covered with protuberances 3–4 mm long. *Seeds* ovate, 6–7 × 4·5–5 mm, medium brown, dorsally and ventrally with trichomes (Fig. 5a); trichomes 0·08–0·1 mm long, regularly

arranged; seed margin wingless, entire; coma 15–20 mm long. For illustration see De Lessert, 1846, plate 10. Map 1.

COLLECTIONS. 35 collections were studied of which the following have been selected as vouchers: Burundi: 3°S 29°E, *Reekmans* 10069 (MO). Ethiopia: Kefa Province, Bonga, forest and waterfall behind the Catholic Mission, 8 Jan. 1973, *Friis* 2156 (K). Kenya: K4, Machakos District, Mwami Hill, 22 June 1957, *Bally* 11550 (K); K6, Masai District, Ngong Hills, 14 July 1957, *Verdcourt* 1798 (K). Malawi: Between Kasungu and Lilongwe, 25 Feb. 1961, *Richards* 14476 (K). Namibia: 17°S 13°E, Swartbooisdrip area, *Dinter* 3416 (SAM). Tanzania: T7, Njombe District, 11 miles from Makumbako on Mbeya road, 23 March 1988, *Bidgood, Mwasumbi & Vollesen* 627 (K); T7, Iringa District, Matanana, 80 miles S of Iringa, 27 March 1982, *Polhill & Paulo* 1884 (K). Zambia: Northern Province, Mbala District, on road to Kaka village, 20 Feb. 1960, *Richards* 12524 (K); Southern Province, Mapanza South, 24 Jan. 1954, *Robinson* 488 (K). Zimbabwe: Shangani District, Gwampa Forest Reserve, 2 March 1955, *Goldsmith* 109/55 (K).

b. Pentarrhinum abyssinicum Decne. ssp. **angolense** (N. E. Br.) Liede & Nicholas comb. & stat. nov. Type: Angola, Icolo e Bengo District, near the Lagoa de Foto, *Welwitsch* 4240 (lectotype K!, isolectotype BM!, designated here).

P. abyssinicum Decne. var. *angolense* N. E. Br. in Thiselton-Dyer. Fl. Trop. Afr. 4, 1: 379–380 (1902). Types: Angola, Ambriza District, Quizembo, *Welwitsch* 4199 (isosyntype BM!); Angola, Loanda District, near Penedo, *Welwitsch* 4237 (isosyntype BM!); Angola, Golungo Alto District, at Elinda in Terra de Bumba, *Welwitsch* 4238 (isosyntypes BM! K!); Angola, Golungo Alto District, along banks of the Quiapose river, *Welwitsch* 4239 (isosyntypes BM! K!); Angola, Icolo e Bengo District, near Lagoa de Foto, *Welwitsch* 4240 (isosyntypes BM! K!); Anhoa, Bumbo District, near Empalanca, *Welwitsch* 4247 (isosyntypes BM! K!); Angola, Ambriz District, along the Kuanza river, *Monteiro* s.n. (isosyntype K!); Zaire, Kisantu in the Inkissi river, *Gillet ex De Wildeman & Durand* s.n. (type not seen).

P. abyssinicum sensu De Wild. & Durand, in Contrib. Fl. Congo, Ann. Mus. Congo, Sér. 2, Bot., 1, 2: 42 (1900), non Decne.?

P. insipidum sensu Hiern, in Cat. Afr. Pl. Welw. 1, 3: 687–688 (1898), non E. Meyer.

P. insipidum sensu Bullock, in Hepper, Fl. West Trop. Afr. 2nd edn. 2: 90 (1963), non E. Meyer.

Plants identical to the type subspecies in most respects, except for some corolla characters. *Corolla* lobes ovate, 6–7 mm long, 4 mm wide, not fully reflexed at anthesis, greenish-yellow, ciliate or, very rarely (*Macaulay* 1137), glabrous, apex acute, base connate.

These plants differ in several corolla characters and also in habitat. Even though they occur in the same area as the type subspecies, only one intermediate (RML 1047 (K) from Zambia) has ever been found. Therefore, subspecific rank seems appropriate for the two taxa. Fig. 2. Map 1.

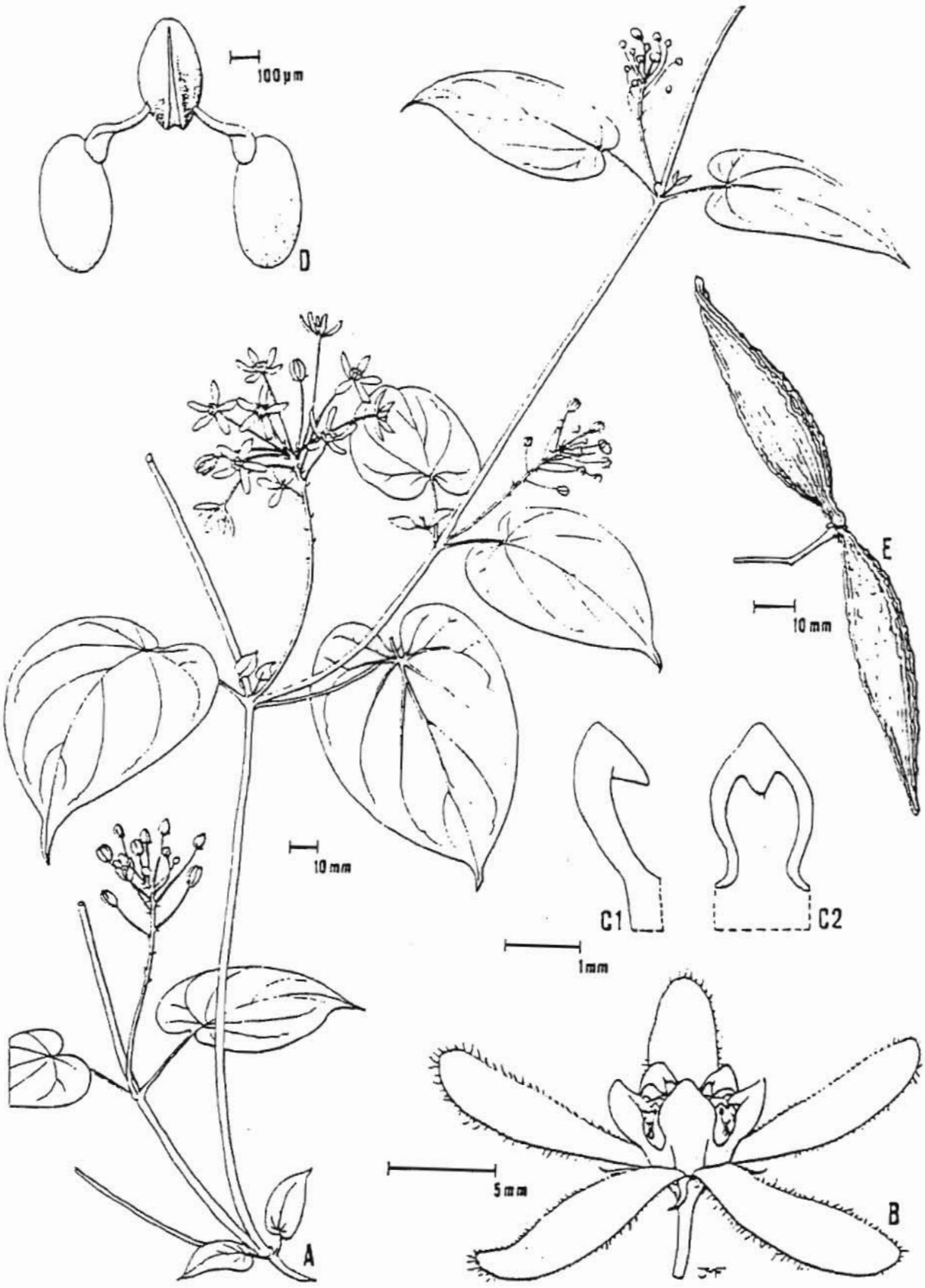


Fig. 2. *P. abyssinicum* Decne. ssp. *angolense*. A habit (*Polhill* 457 (K)); B flower (*Polhill* 457 (K)); C corona lobe, 1 side view, 2 front view (*Polhill* 457 (K)); D pollinarium (*Polhill* 457 (K)); E follicles (*Gossweiler* 790 (K)). Drawn by Mark Fothergill.

COLLECTIONS. 30 collections were studied of which the following have been selected as vouchers: Angola: Malanje District, *Gossweiler* 790 (BM, K); Bengo District, near Lagoa de Foto, *Welwitsch* 4240 (K). Cameroon: Mt. Cameroon, near Mann's Spring, 29 March 1948, *Brenan* 9510 (BM, K). Kenya: K5, 6 kilometres from Kapsabet on road to Eldoret, 13 Oct. 1981, *Gilbert & Mesfin* 6716 (K). Malawi: Dedza Region, Dedza Mountain, on road to main peak, 10 April 1980, *Blackmore, Banda & Patel* 1214 (K); Nkhata Bay District, 2 miles south east of Chikangawa, 31 July 1978, *Phillips* 3654 (K). Namibia: Otjosondu District, Okakango, 27 July 1910, *Dinter* 474 (BM, K, MO); Grootfontein District, Farm Kumkauas, 7 March 1974, *Merxmüller & Giess* 30120 (K). Tanzania: T3, Lushoto District, Jaegertal valley, W. Usambaras, 21 June 1953, *Drummond & Hemsley* 2970 (K). Uganda: U3?, 2nd day's march from Nandi, Nov. 1898, *Whyte* s.n. (K). Zaire: Volcano, Karisimbi, 17 Oct. 1937, *Louis* 5253 (K). Zambia: Central District, Mumbwa, July 1912, *Macaulay* 1137 (K).

2. **Pentarrhinum insipidum** *E. Meyer*, Comm. Pl. Afr. Austr. 200 (1837); Decne, in DC. Prodr. 8: 553 (1844); Schum., in Engl. & Prantl, Nat. Pflanzenfam. 4, 2: 244 (1895); Schltr., Bot. Jahrb. Syst. 45: 23 (1894); Schltr., J. Bot. 34: 456 (1896); N. E. Br. in Thiselton-Dyer. Fl. Trop. Afr. 4, 2: 378–379 (1902); N. E. Br., in Thiselton-Dyer, Fl. Cap. 4, 1: 741–742 (1908); Pole Evans (ed.). Flower. Pl. Afr. 11: t.423 (1931); Compton. Fl. Swaziland: 458 (1976); Malaisse, Fl. Rwanda 3: 108 (1985). Typus: Enon, Uitenhage Div., South Africa: *Drège* 2220 (holotype destroyed, lectotype K!, designated here).

Plants herbaceous, richly branched, twining; shoots annual, 200–300 cm long, 1–3 mm diam. at the base, glabrous to sparsely pubescent; trichomes 0·25 mm long, multicellular, flexuose; base weakly woody with yellowish bark. *Roots* elongated tubers. *Leaves*: Blades cordiform, 23–65 × 20–50 mm; base cuneate to cordate; apex acute to acuminate, 0·5–3·0 mm long; adaxial surface glabrous to weakly pubescent; trichomes equally distributed over the whole surface, 0·25 mm long, multicellular, flexuous; abaxial surface glabrous to weakly pubescent; trichomes concentrated along the veins and margins, isolated to sparse, 0·25 mm long, multicellular, appressed; petiole 17–50 mm long; 4–9 colleters at the base of the leaf. *Inflorescence* cymose, 5–15-flowered; peduncle 30–40 mm long, sparsely pubescent; trichomes 0·25 mm long, multicellular, flexuous; rachis 5–20 mm long, straight. *Flowers* fragrant, scent aromatic; bracts 0·75 × 0·2 mm wide, triangular, with hairs; pedicel 5–20 mm long, indumentum unifarious; buds depressed-conical 2·5–3·5 mm long, 4·5–5·5 mm diam.; corolla lobes imbricate in bud, dextrorse. *Calyx* rotate; sepals triangular, 1·5–2·5 × 0·7–0·9 mm wide, apex acute, base connate; abaxial surface pubescent and ciliate. *Corolla*: lobes ovate to oblong, fully reflexed at anthesis, 4–6 mm long, 2·5–3·5 mm wide at the base; green to yellow (often apically purple-brown); ciliate; apex rounded, bases connate. *Corona* 2·5–3·0 mm high, equalling the gynostegium, ivory to yellow, papillose, fleshy; staminal and interstaminal parts basally connate; staminal parts laterally conduplicate, apically cucullate, resulting in a horn-like ornament projecting towards the gynostegium (Fig. 6). *Gynostegium* sessile, 2·5–3 mm high, 2 mm diam. *Anthers*: connective appendages

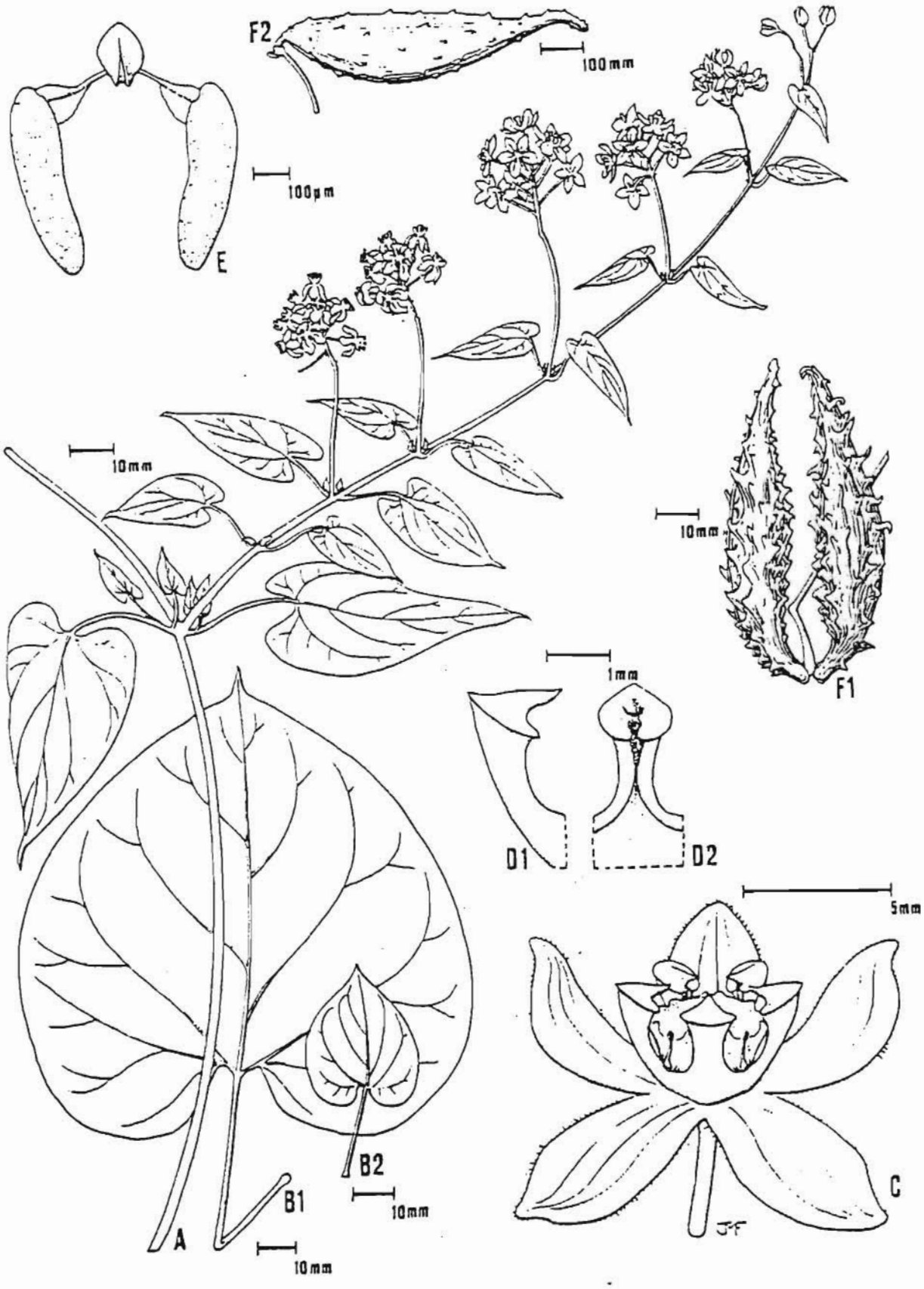


FIG. 3. *P. insipidum* E. Meyer. **A** habit (*Drummond & Hemsley* 3062 (K)); **B** leaves, 1 (*Polhill & Paulo* 726 (K)), 2 (*Milne-Redhead & Taylor* 11310 (K)); **D** corona lobe, 1 side view, 2 front view (*Drummond & Hemsley* 3062 (K)); **E** pollinarium (*Drummond & Hemsley* 3062 (K)); **F** follicles 1 (*Bally* 9110 (K)), 2 (*Pope* 86 (K)). Drawn by Mark Fothergill.

depressed ovate, 0·2 × 1 mm, inflexed; anther wings 0·5 mm long; straight, parallel, double, bristly inside. *Pollinarium*: corpusculum 0·2–0·25 mm long, triangular; pollinia elliptic, 0·55–0·6 mm long, 0·14–0·16 mm wide (Fig. 4b). *Gynoecium*: Style apex 0·3–0·35 mm high, 1·2–1·3 mm diam., flat. *Fruit*: follicles one, occasionally two per flower, 55–85 mm long, 15–20 mm wide, ellipsoid, round in cross section, apically shortly beaked, light brown, glabrous to scarcely pubescent; nearly smooth to densely covered with protuberances; protuberances 2–4 mm long. *Seeds* ovate, 6·0–6·5 × 2·0–2·3 mm, medium to dark brown; dorsally and ventrally papillose; papillae arranged in longitudinal ridges (Fig. 5b); seed margin winged; wing 0·2 mm wide, laterally entire, apically dentate; coma 30–40 mm long. *Chromosome number*: 2n = 22 (*Lieste & Meve* 584a). Fig. 3. Map 2.

Collections. 270 collections were studied of which the following have been selected as vouchers: Botswana: Ngamiland District, Horseshoe bend of Kwando river mainstream, 1 Feb. 1978, *Smith* 2329 (K, PRE). Burundi: 3°S 29°E, *Reekmans* 1537 (MO). Ethiopia: Mountains near Deli Dikeno, Sept. 1854, *Schimper* 2175 (BM, K). Kenya: K1, Northern Frontier Province & District, Gelai, 10 km ESE of Baragoi, 17 Nov. 1977, *Carter & Stannard* 495 (K, SRGH). Malawi: Dedza District, Chongoni Forest Reserve, 17 Feb. 1968, *Salubeni* 960 (K). Mozambique: Maputo District, Costa do Sol, Campo de Golfo, 30 March 1960, *Balsinhas* 150 (K). Namibia: Omaruru District, 28 km from Omaruru on road to Kalkveld, 2 March 1983, *Germishuizen* 2520 (K, PRE). Rwanda: Biumba Province, Mutara Region, near Mimuli, 5 Nov. 1957, *Troupin* 5174 (K). Somalia: Hargeysa, 21 Sept. 1932, *Gillet* 3921 (K). South Africa, Transkei, near Clydesdale, March 1886, *Tyson* 1320 (BM, BOL, K, PRE, SAM). Sudan: Jebel Marra, at foot near Sunit Darfur, *Jackson* 3315 (K). Swaziland: *Dlamini* s.n. (NBG 39573). Tanzania: T7, Iringa District, Great North road, 5 miles south of crossing the great Ruaha river, 2 Feb. 1962, *Polhill & Paulo* 1318 (K). Uganda: U4, Bugerere, near Busana, April 1932, *Eggeling* 375 (K). Zaire: Kivu Province, Beni Region, Albert National Park, 25 Oct. 1954, *de Witte* 11330 (K). Zambia: Livingstone District, Victoria Falls, Palm Grove, 8 Jan. 1972, *Kornas* 815 (K).

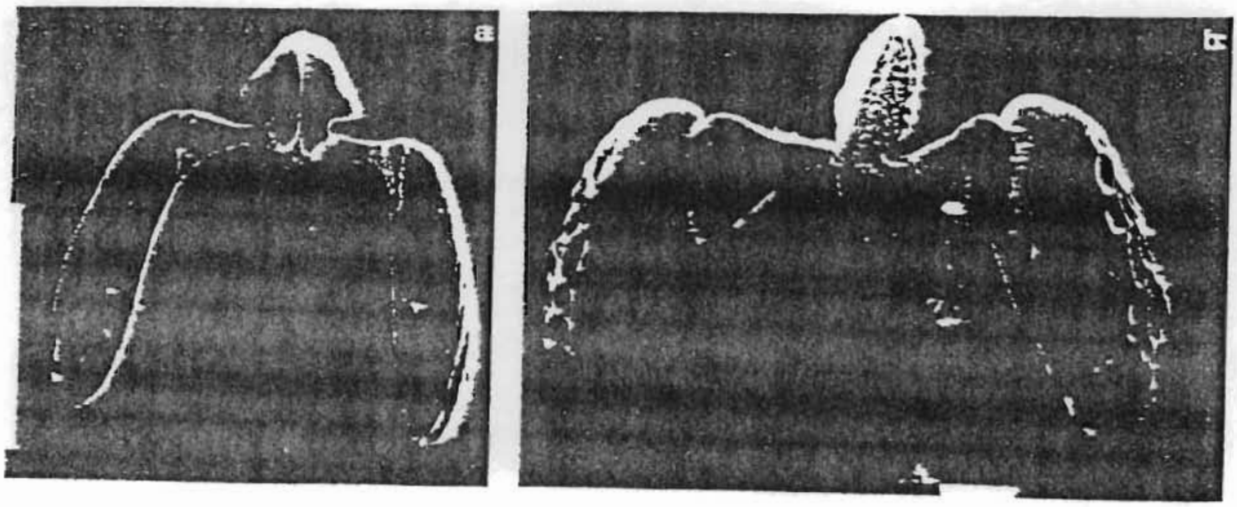


Fig. 4. Pollinaria. a *P. abyssinicum* (bar length 0·5 mm); b *P. insipidum* (bar length 1 mm). SEM micrographs of critical point dried material.

Zimbabwe: Manicaland, Odzi river, 13 Feb. 1963, *Chase* 7957 (K).

EXCLUDED SPECIES

Pentarrhinum coriaceum Schlechter in J. Bot. 32: 337 (1894). Type: *Gerrard & McKen s.n.* (holotype, not traced).

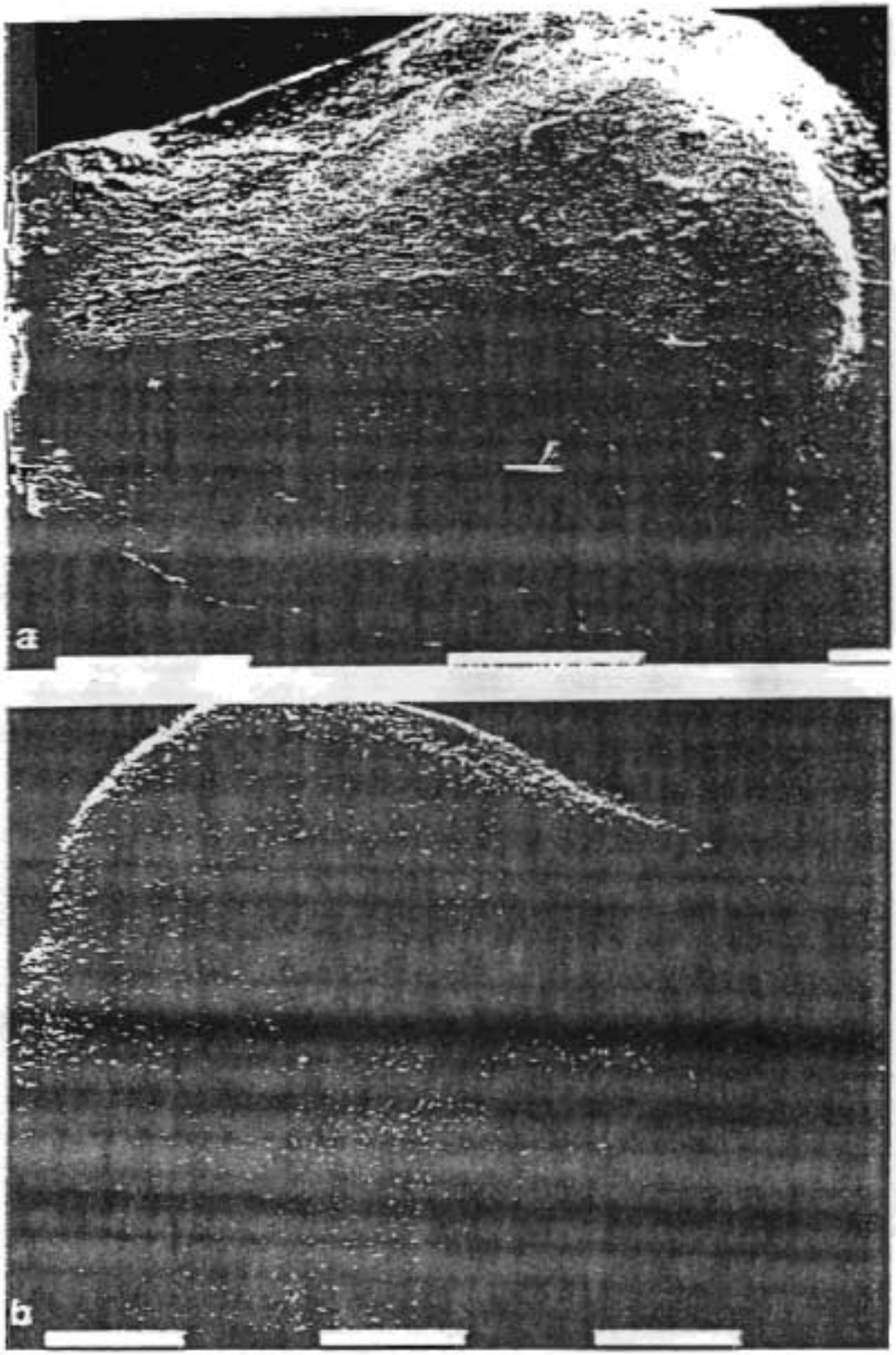


FIG. 5. Seeds. a *P. abyssinicum*; b *P. swapidum*; SEM micrographs of air-dried material (hair length 1 mm).

The type of this species could not be traced. N. E. Brown (1908) indicated that he had been unable to trace the specimen at BM, DBN, K or NH. The description, as N. E. Brown (1908) remarked, does not fit the genus *Pentarrhinum*. The taxon most probably represents a member of the genus *Tylophora* R. Br.

Pentarrhinum fasciculatum K. Schumann in Engl. Pflanzenw. Ost-Afrikas Theil C: 323 (1895). Type: *Stuhlmann* 809, (holotype, not traced; isotype K!). This type clearly represents a specimen of *Pentatropis nivalis* (J. F. Gmelin) D. V. Field and J. R. I. Wood (1983), and must be treated as a synonym under this name.

Pentarrhinum fringense Markgraf in Notizbl. Bot. Gart. Mus. Berl. 11: 404 (1932). Type: *Schlieben* 557, (holotype not traced, isotype BM). Examination of the isotype reveals that this taxon is a member of *Tylophora* R. Br.

Pentarrhinum tylophoroides K. Schumann in Engler & Prantl, Nat. Pfl. Fam. 4, 2: 244 (1895). Type: *Burchell* s.n. (holotype, not traced). The extremely short diagnosis by Schumann (1895) does not allow a clear recognition of the taxon's identity and the type could not be traced because of the absence of a collecting number and the lack of any indication of the herbarium in which it is housed. Its rounded leaves and paniculate inflorescences suggest that, again, the taxon belongs in the genus *Tylophora*.

ACKNOWLEDGEMENTS

Work in the subtribe *Cynanchinae* at the Missouri Botanical Garden was made possible by a NATO Postdoctoral Fellowship (SL). The enthusiastic support of the staff at MBG is gratefully acknowledged. For the loan of specimens we thank the directors of BOL, K, NBG, PRE, SAM and STE. For the chromosome count

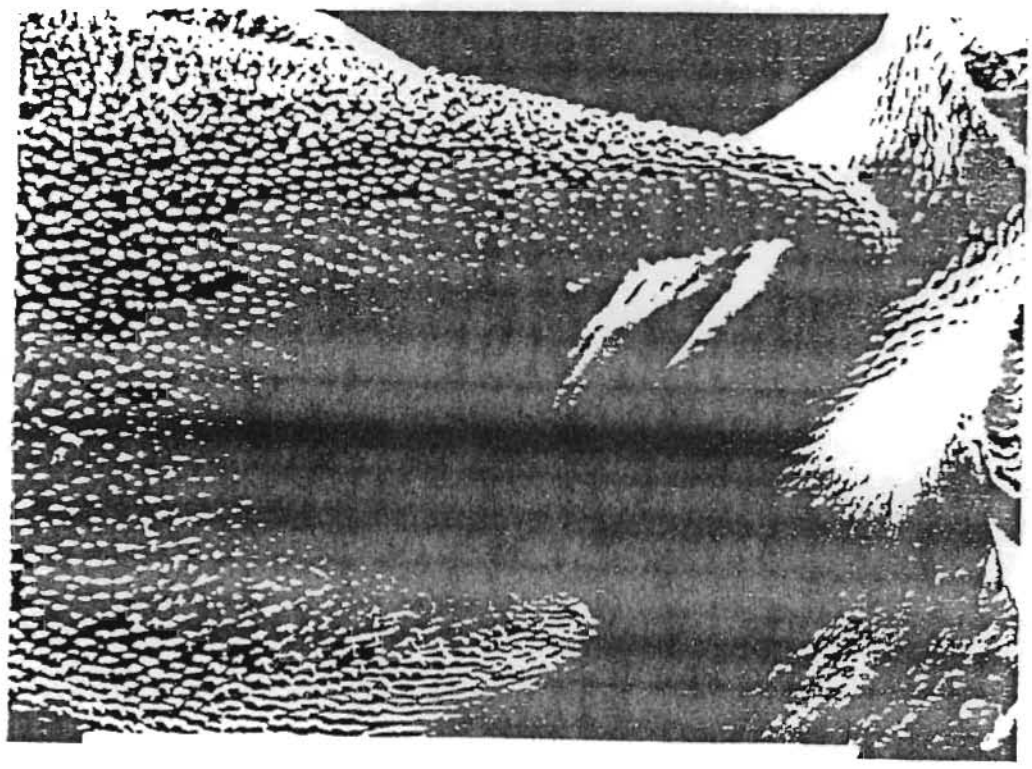


FIG. 6. Corona structure in *P. insipidum*, SEM micrograph of critical point dried material (bar length 1 mm).

we owe thanks to U. Meve, Münster, FRG. The authors would also like to thank all those herbaria who allowed us access to their collections and facilities. Lastly, our thanks go to J. M. Fothergill for the drawings, and to the referees for their constructive criticism.

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CHAPTER 4.5.2

A TAXONOMIC REASSEMENT OF THE GENUS *EUSTEGIA* R.Br. (APOCYNACEAE: ASCLEPIADOIDEAE)

"Among empirically orientated researchers, the myth is prevalent that a true scientist proceeds ftom the observation of facts without any preliminary concepts and hyotheses. In the philosophical literature this myth has been called the 'fallacy of *tabula rasa*'... however, the description of facts without preliminary ideas and concepts is logically impossible." - Takhtajan* 1991.

CONTENTS

* TAKHTAJAN, A. 1991. **Evolutionary Trends in Flowering Plants.** New York, Columbia University Press.

A TAXONOMIC REASSESMENT OF THE GENUS *EUSTEGIA* R. BR. (APOCYNACEAE: ASCLEPIADOIDES)

A. Nicholas* & H. Baijnath*

Abstract

The genus *Eustegia* is removed from the subtribe Asclepiadinae and reduced from five species to three.

Introduction: The most striking feature of *Eustegia* R. Br. is that it has the corona in three series (N.E. Brown, 1908 and Dyer, 1975). However, we believe the corona may be in two series only, with the inner series actually being part of the so called middle series, possibly arising as a much exaggerated appendage from the bottom of the inner surface, together they form what is the inner coronal whorl or interstaminal corona in other asclepiads. This interpretation is much more consistent with the fact that the inner corona-lobes are opposite the middle-corona lobes rather than alternating with them, which is what would be expected if it were a different series. Hopefully, in time, this interpretation can be tested using anatomical and ontogenetic studies. Whatever the case, the corona of this genus, in which the lobes of the three series are basically of equal status, is much more like that of the genus *Fockea* (tribe Fockeeae Kunze *et al.*, 1994) or to some members of the subtribe Cynanchinae *sensu* K. Schumann (1895) (the Metastelmatinae Endl. ex Meisn. of Liede, 1997) than to the rest of the Asclepiadinae. In some Cynanchinae the two coronal whorls are more or less of equal status, whereas in the Asclepiadinae there is usually just the outer coronal whorl or staminal corona (Liede & Kunze, 1994), although often a second series or interstaminal corona is also present (Kunze, 1997). However, if present, then the interstaminal corona (= outer corona) is never of the same status as the staminal corona (= inner corona). In the Asclepiadinae, the staminal corona is always larger and more dominant than the interstaminal corona which is small, rudimentary, vestigial or absent. For this reason we agree with Liede (1997) that *Eustegia* should be removed from the Asclepiadinae. However, if removed from the

* Botany Department, University of Durban-Westville, Private Bag 54001, Durban 4000, Natal, South Africa

Asclepiadinae the problem then remains in which subtribe to place it. In general, the vegetative facie and flower structure of *Eustegia* resembles some *Cynanchum* species, in particular *C. orangeanum*, however, it differs from this genus in its corona structure. On the other hand, the corona-lobe structure is more like that found in *Fockea*, the corolla and follicle structure also fits in well here, as does the predominantly western distribution of both taxa. However, vegetatively *Fockea* and *Eustegia* are quite different, but more fundamentally the two taxa differ in the orientation of the pollinia (which is erect in *Fockea*) and the structure of the pollinarium. N.E. Brown (1908) in **Flora Capensis** placed *Eustegia* near *Emicocarpus*, another genus with the corona apparently in three series. However, any similarity is probably due to convergence rather than common ancestry. *Emicocarpus*, being a mesophytic procumbent herb, is very different to the xerophytic *Eustegia* in almost all other features. In particular, the palmately lobed leaves, indehiscent one-seeded obtriangular follicles adorned apically with three spreading spines and comaless seeds of *Emicocarpus* are totally at odds with these features in *Eustegia* and are, in fact, highly usual in the Apocynaceae. Liede (1997) placed *Eustegia* in the Astephaninae, a subtribe she has expanded to include genera as diverse as *Emicocarpus*, *Tylophora* and *Vincetoxicum*. We are reluctant at this time to adopt her system and prefer Schumann's treatment (1895) which included a group of genera without a staminal corona, but sometimes with a corolline corona. Southern African genera that typify the Astephaninae, as envisioned by us, are *Astephanus* (African species only) and *Microloma*. *Eustegia* does not fit well here as it not only possesses a staminal corona, but has quite a different vegetative and perianth morphology. The only genera in the Asclepiadinae that approach *Eustegia* are *Woodia* (particularly *W. fluviale*), *Stenostelma* (particularly some as yet undescribed species) and some species previously placed in *Schizoglossum* (such as *S. eustegioides*). However, the resemblance to these is only vegetative, *Eustegia* differs from them in its perianth, corona, anthers and gynostegial-column. *Eustegia* also appears to have a normal rootsystem rather than a stem-tuber typical of these genera; although this still needs to be verified by anatomical investigation. It doubtfully shares a common ancestry with any of these and any vegetative similarities may be due to convergence. Until the problem can be resolved, we have opted, as done with *Pentarrhinum* (Liede & Nicholas, 1992) to place *Eustegia* in the

subtribe Cynanchinae. Because of this we have not included it in the two papers so far produced during which we revised the genera of the Asclepiadinae in southern Africa. However, as *Eustegia* has traditionally been considered part of the Asclepiadinae we have for completeness revised it here.

R. Brown (1810), when he proposed the genus, mentions three species: *E. hastata*, *E. minuta* and an unnamed species. Decaisne (1844) expanded this to four species *E. hastata* (under which he sank *E. minuta*), *E. filiformis*, *E humilis* and *E. lonchitis*. Schumann (1895) later reduced the number to three: *E. filiformis*, *E. hastata* and *E. humilis*. N.E. Brown (1908) during his thorough treatment of the family Asclepiadaceae for South Africa increased the number to five, not only taking on board species proposed by Schlechter (1895) and Schinz (1894), but also one he named himself. Arnold & de Wet (1993) list N.E. Brown's species as follows: *E. filiformis* Schultes, *E. fraterna* N.E. Br. (which N.E. Brown divided into two varieties var. *fraterna* and var. *pubescens* N.E. Br.), *E. macropetala* Schltr., *E. minuta* (L.f.) R. Br. and *E. plicata* Schinz. Examination of the material available to us suggests that this genus consists of three species. Two of the three species are in need of some protection, although the genus is not mentioned in the **Red Data Book** of Hilton-Taylor (1996).

EUSTEGIA R. Br., in Mem. Werner. Soc. 1: 51 [1809] *non* Rafin. Sylva Tellur.: 95 [1838]. **Type species:** *Eustegia minuta* (L.f.) N.E. Br. (See Bullock 1953).

Description: *Habit:* Small, perennial geophytic herb; with milky latex. *Underground organ:* A stem-tuber. *Stems* many, branched at the base, short, decumbent to ascending, 50—110mm long, sometimes densely leafy, unifariously pubescent, pubescent or puberulous, rarely densely pubescent. *Leaves* opposite, small, simple, entire or appearing lobed at the base, spreading to erect, sessile or subsessile; lamina linear-filiform, linear-hastate to filiform-hastate, rarely lanceolate, ovate or elliptic near the stem base, 4.5—38.0mm long, with or without a short acute spreading tooth on each side at the base, apex acute, base cuneately narrowing, margins smooth to revolute, glabrous, sparsely & irregularly ciliate or pubescent, densely pubescent on both sides; petiole very short. *Inflorescences* umbel-like, produced laterally at the nodes, 2—8-flowered; peduncles

4.5—45.0mm long, unifariously or bifariously puberulous or pubescent, rarely densely pubescent; bracts lanceolate-subulate, 1.2—1.7mm long, apex acute. *Flowers* dull green, green or olive green; pedicels 3.4—9.0mm long, puberulous on the one side, rarely densely pubescent. *Calyx* 5-merous, sometimes with septal glands; lobes ovate to ovate-lanceolate, 1.2—2.2mm long, 1.2mm wide, apex acute to subacute, glabrous to very thinly hairy. *Corolla* 5-merous, erect to spreading-erect, campanulate, divided almost to base; petals ovate-oblong, oblong to oblong-lanceolate, 3.4—8.0mm long, 1.5—4.5mm wide, sometimes slightly twisted, apex obtuse, margins more or less revolute, glabrous on both sides. *Staminal-corona* in 3-series, membranous, white sometimes with purple margins, arising from the gynostegial-column base; *outer-corona* 5 merous, lobes opposite the corolla-lobes, linear, oblong-linear to oblong or spathulate to suborbicular, 1.0—2.2mm tall, 0.55—0.7mm wide, entire, same width through-out or narrower at the base, apex rounded to subtruncate & entire or emarginate to bifid, broader at the base, shorter than or level with the style-apex, inner surface with or without a large gibbosity near the apex or apex thickened or with a thickened longitudinal keel, shorter than the style-apex; *middle-corona* 5-merous; lobes alternating with the outer-corona, rarely fused at the base for ¼—½ of its length, usually almost free to the base, free parts usually linear, sometimes oblong, 1.7—2.8mm tall, 0.3—0.4mm wide, more or less simple or divided into a larger middle lobe flanked by 2 smaller sublobes, inner surface with a large sometimes rounded gibbosity at the base or in the middle, base & sides of the sublobes or united part more or less dilated into inflexed auricles or teeth, entirely smooth & without auricles, sublobes sometimes subfalcate or without sublobes but with basal triangular auricles, apex of main lobe obtuse, apex of sublobes acute to obtuse, shorter than, level with or just overtopping the style-apex; *inner-corona* 5-merous; lobes opposite the middle-corona, sometimes slightly incurved, linear, linear-oblong to linear-lanceolate, 0.7—1.7mm tall, ±0.5mm wide, entire, concave, apex subacute, attenuate, obtuse or broadly rounded with tips pressed against the base of the style-apex or just overtopping it. *Staminal-column*; anther-appendages shortly erect, ovate or semicircular, membranous. *Pollinaria*: Pollinia solitary, pendulous in each anther-sac, ovate-oblong, attached apically by translator-arms that are as long as the pollinia, corpusculum small with lateral translucent wings. *Style-apex* exerted, stout or slender, produced 0.75—1.7mm beyond

the anthers, 0.6—0.8mm thick, ovoid-oblong, oblong, cylindrical or narrowly conical, apex obtuse. *Follicles* usually solitary, more or less fusiform, 70—80mm long, surface smooth.

Distribution: South African endemic [Western Cape and Northern Cape provinces only].

Key to Species:

1a. Corolla 7 to 8mm long ..... *E. macropetala*

1b. Corolla 3 to 5mm long 2

2a. Corona-lobe of middle series with inflexed triangular ear-like projections at the base (not 3-sublobed) ..... *E. plicata*

2b. Corona-lobe of middle series deeply divided into a large central lobe with two almost equal sublobes on either side ..... *E. minuta*

1. *Eustegia plicata* Schinz., *in* Bull. Herb. Boiss. 2(3): 218 [1894]. **Type:** *Bachmann 1995,* South Africa, Western Cape province, Malmesbury Division, Hopefield [*n.v.*].

Discussion: Unlike the species which follow, the lobes of the middle corona-lobe series have inflexed triangular ear-like projections at their base or these square and shoulder-like. We have interpreted this structure as being plesiomorphic, which is why we have placed it first in our series. We have chosen to view this character as primitive, based on our experience that increased ornamentation of the corona-lobe is usually, but not always, a derived condition. We do concede, however, that others could interpret them as being apomorphic. In the other species in this genus these lobes are divided into a larger middle segment flanked at the base by two lateral slightly smaller sub-lobes. This species flowers in December and is found at altitudes of about 100 meters.

Distribution: South African endemic [Western Cape province only].

Conservation status: Critically Endangered.

Representative Specimen: South Africa: Western Cape: *Schlechter 10755*, Piquetberg division, near Piquiniers Kloof [PRE].

2. ***Eustegia minuta*** **(L.f.) N.E. Br.**, in Fl. Cap. 4(1): 761 [1908]. **Type:** *Thunberg s.n.*, South Africa, Western Cape province, Cape Town, below lion mountain* [*n.v.*].

Apocynum minutum L.f., Suppl.: 169 [1781]. **Type:** As above.

Asclepias hastatum Thunb., Prodr. Pl. Cap.: 47 [1794]. **Type:** *n.v.*

Eustegia hastata (Thunb.) Schultes, in Roem. & Schult. Sys. Veg. 6: 119 [1820]. According to Bullock (1953) this is the *Eustegia minuta* (L.f.) R. Br. of Flora Capensis, but this latter name should be attributed to N.E. Brown. **Type:** As above.

Eustegia fraterna N.E. Br., in Fl. Cap. 4(1): 760 [1908]. **Types:** *Zeyher 4697*, South Africa, Western Cape province, near Green Point [Iso. PRE]; *Prior (Alexander) s.n.*, South Africa, Western Cape province, near Green Point [*n.v.*]; *Harvey s.n.*, South Africa, Western Cape province, Cape Town [*n.v.*]; *Harvey s.n.*, South Africa, Western Cape province, Cape Town, Lion Mountain [*n.v.*].

Discussion: The most consistent character defining *E. minuta* is the deeply 3-sublobed middle corona-lobe. Based on vegetative facie and corona-lobe structure, this species, which is the most widespread of the three, can be divided into two varieties.

Key To Varieties:

1a. Basal leaves ovate, base rounded ..... var. *minuta*

1b. Basal leaves linear to filiform, base tapering or hastate ..... var. *filiformis*

2a. ***Eustegia minuta*** (L.f.) R. Br. variety ***minuta***

Discussion: Being consistently smaller and with the basal leaves ovate, variety *minuta* is vegetatively distinct. Also, the middle corona-lobe series may be shorter than the style-apex and with the long side sublobe fused to the main lobe for ¼ to ½ of their length. The stems are unifariously pubescent. The lobes of the outer-coronal series are 1.7mm long, 0.3mm wide, shorter than the style-apex, linear-oblong in shape, the apex rounded and the inner face with a large gibbosity near the apex. This variety is localized, being found

* Probably Lionshead

only in the vicinity of Cape Town. As a result, we have decided to follow N.E. Brown (1908) who suggested that one of its synonyms, *E. fraterna*, may only be a variety of *E. minuta*; following the **Code** (*Greuter et al.*, 1993) we have used the older name *minuta*.

Distribution: South African endemic [Western Cape province only].

Conservation status: Critically Endangered. Populations confluent or adjacent to Cape Town are particularly at risk.

Representative Specimens: South Africa: Western Cape: *Schlechter s.n.*, Rondebosch [PRE 5899]; *Marloth 8931*, Without locality [PRE fruits only].

2b. *Eustegia minuta* (L.f) R. Br. variety ***filiformis*** (L.f.) Nicholas. *Comb. et Stat. nov.*

Eustegia filiformis (L.f.) Schultes, in Roem. & Schult. Sys. Veg. 6: 120 [1820]. **Type:** *Thunberg s.n.*, South Africa, Western Cape province, near Hopefield [*n.v.*].

Apocynum filiforme L.f., Suppl.: 169 [n.v.]. **Type:** As above.

Eustegia humilis E. Mey., Comm. Pl. Afr. Austr.: 221 [1838]. **Type:** *Drége s.n. (III, A, a)*, South Africa, Western Cape province, between Leliefontein & Krakkeelkraal, in grasslands. 1066—1220m [*n.v.*].

Eustegia lonchitis E. Mey., Comm. Pl. Afr. Austr.: 221 [1838]. **Type:** *Drége s.n. (III, D, a)*, South Africa, Western Cape province, between Paarl & Simonsberg, in grasslands, 152m [*n.v.*].

Eustegia fraterna N.E. Br. variety *pubescens* N.E. Br., in Fl. Cap. 4(1): 760—761 [1908]. **Type:** *Schlechter 10710*, South Africa, Western Cape province, Tulbagh Division, hills near Piquetberg Road (Gouda), 122m [*n.v.*].

Discussion: We have not had an opportunity to examine the type, but have dissected two specimens (*Schlechter 5306 & Bolus 12767*, in NH) that were collected at the type locality near Hopefield. As pointed out by N.E. Brown (1908) E. Meyer (1838) recognized three species (*E. filiformis*, *E. humilis* & *E. lonchitis*) based on differences in the style-apex, particularly their robustness, but this character appears to be variable and of little specific significance. However, it has this feature in common with variety *minuta* in having filiform or linear leaves throughout, although the base may sometimes be hastate. This feature, however, it has in common with *E. macropetala*. Unlike this species, though, it has much smaller petals and the middle series of corona-lobes are

without distinct auricles on their lateral sublobes. In some specimens the stems, peduncles and pedicels are densely hairy, these were placed by N.E. Brown (1908) in *E. fraterna* variety *pubescens*. He also maintained that the outer corona-lobes of this variety were narrow at the base widening to a broad apex. However, these characters are not consistent and we have been unable to maintain this variety as distinct. This is the most widespread taxon in *Eustegia*. Plants occur in deep sandy veld, in level stony soil surrounded by Karroid shrubs or in Renosterveld. Variety *filiformis* is found at altitudes of between 15 and 800 meters. The scented flowers are pinkish white and are produced from August to September, sometimes as late as October.

Distribution: South African endemic [Western Cape & Northern Cape provinces].

Conservation status: Low Risk (Least Concern). Populations in and near Cape Town, Paarl and Stellenbosch should be considered vulnerable. Elsewhere, especially on the many inaccessible mountains on which it occurs (such as the Cedarberg), it is, to an extent, protected.

Representative Specimens: South Africa: Northern Cape: *Schlechter 11186*; Riet Kloof [PRE]. Western Cape: *Davidson 52 & 52b*, Hex River Valley [SAM]; *Bolus 12767*, near Hopefield [NH]; *Schlechter 5306*, Hopefield [NH, PRE]; *Muir 4499*, Snyman's Kraal, Riversdale distr. [PRE]; *Marloth 11532*, Mouton farm valley, Piquetberg [PRE]; *Story 3073*, near Caledon on road to Swellendam [PRE]; *Acocks 22662*, Onverwacht, near Riviersonderend [PRE]; *Strey 723*, Stellenbosch flats [PRE]; *Bolus 11811*, Hex River, near de Dooms [PRE]; *Adamson 1053*, Cold Bokkeveld [PRE]; *Kruger 18*, Jonkershoek [PRE]; *Bolus s.n.*, Constable, Touws River district [PRE].

3. ***Eustegia macropetala*** Schltr., in Journ. Bot.: 358 [1895]. **Type:** *Schlechter 5213*, South Africa, Western Cape province, Piquetberg Division, sandy places at the foot of Piquetberg Mountain, 305m [n.v.].

Discussion: This species is vegetatively similar to *E. filiformis* subsp. *filiformis*, but it differs from this species and from *E. plicata* in its much longer petals and middle series of corona-lobes which have round, ear-like projections on their lateral sublobes. This species occurs in deep white sand and flowers in about August.

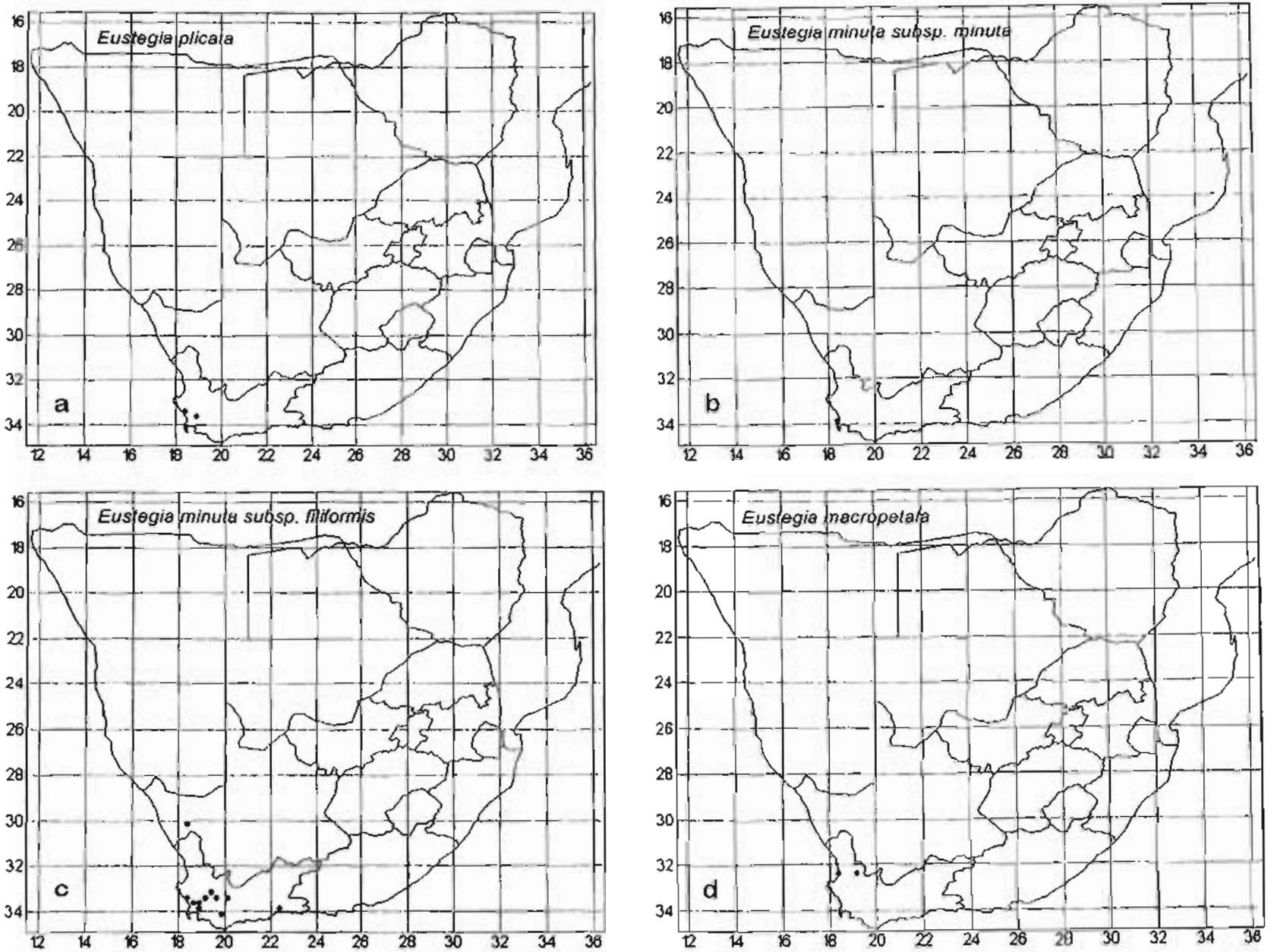

Figure 1. Distribution maps for *Eustegia*: a. *E. plicata*, b. *E. minuta* subsp. *minuta;* c. *E. minuta* subsp. *filiformis* and; d. *E. macropetala*.

Distribution: South African endemic [Western Cape province only]

Conservation status: Low Risk (Near Threatened). Populations occurring on the Piquetberg which is subjected to aforestation and some agriculture are especially at risk.

Representative Specimens: South Africa: Western Cape: *van Wyk 2565a*, Cedarberg, near Algeria [PRE].

Excluded Names

Eustegia Rafin. = **Melastomataceae**

Eustegia hastata sensu Sieber ex Decne. = ***Microloma sagittatum* R. Br. (Apocynaceae)**

Eustegia mutisii Rafin. = ***Centronia mutisii* (Melastomataceae)**

Eustegia pulverulenta Rafin. = ***Pogonanthera pulverulenta* (Melastomataceae)**

Eustegia tomentosa Rafin. = ***Miconia tomentosa* (Melastomataceae)**

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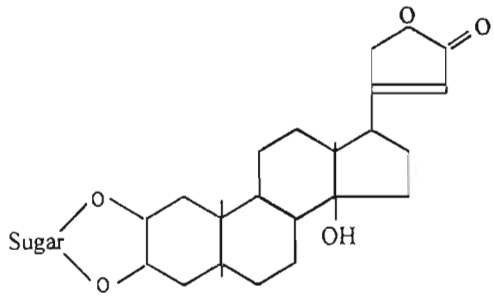
CHAPTER 5

CHEMOTAXONOMY



Generalised Cardenolide

CONTENTS

CHEMOTAXONOMIC STUDIES IN THE SUBTRIBE ASCLEPIADINAE (APOCYNACEAE: ASCLEPIADOIDEAE) IN SOUTHERN AFRICA

A. Nicholas*, B.C. Rogers* & H. Baijnath*

Abstract

The secondary metabolite profiles of 39 species in (17 genera) of the subtribe Asclepiadinae in southern Africa were investigated using one dimensional TLC. Three solvent systems with the ability to move molecules of varying polarity were used. Visual pigments were also examined. The results are mixed sometimes confirming morphological patterns and some times conflicting with them. On the whole chemical patterns agree with generic patterns. *Xysmalobium* and *Gomphocarpus* have the simplest profiles and *Pachycarpus* the most complex. Distinct phylogenetic relationships between some of the genera are also confirmed. Results suggest that *Xysmalobium*, *Gomphocarpus*, *Pachycarpus*, *Aidomene* and *Pachycaris* had a common origin. *Stenostelma* and *Bruynsia* also seem to have come from a common ancestor. *Schizoglossum* has a matchless pattern. Many genera have species with unique profiles, while others have species profiles that show few differences. Similarly some species show great infraspecific variation (populations sampled being spatially and temporally separated) and in others populations are similar. Different plant parts in *Gomphocarpus fruticosus* have the same profiles, while in *Pachyacris parviflora* the flowers are richer in more polar chemicals and the leaves richer in less polar substances.

INTRODUCTION

In 1886 Abbott was the first botanist to correlate chemistry with phylogeny. She discovered that all saponin bearing plants are closely related and could, thus, postulate a common origin for them. Following her study the use of chemical characters in taxonomy grew slowly, only becoming fashionable and widely used from the 1950's onwards

* Botany Department, University of Durban-Westville, Private Bag 54001, Durban 4000, Natal, South Africa

(Cronquist, 1980). This due, mainly, to the advent of new equipment and the development of new techniques; in particular chromatography. Despite its seemingly recent origins, the grouping of plants according to chemical similarities actually dates back to the ancient Greeks who grouped mint and its allies together according to their smell; marking the beginnings of the Lamiaceae. In recent times, the investigation of plant chemical structure has intensified as the search for natural plant products of medicinal importance has become economically important (Dakora, 1995; Marles & Farnsworth, 1995 and; Miró, 1995)

It is because chemical characters are either present or absent (i.e. all or nothing), that they have proved to be taxonomically useful. Although this is disputed by Figueiredo *et al.* (1995) who maintain that the widespread occurrence of parallelisms and convergence make their use problematic. Many compounds are known to be polyphyletic (Stace, 1989). Tropane alkaloids have evolved separately in a number of unrelated plant groups (Romeike, 1978). It is because of this that some workers maintain that the presence of a particular chemical pathway is of more significance than the products produced. But even this is not infallible, some pathways can be analogous rather than homologous (Sivarajan, 1991), as can be seen in the CAM pathway which has evolved independently a number of times. We need to know more about how evolution operates on chemical pathways (Gottlieb, 1980). In particular, during pathways evolution, stages maybe added, or lost (not necessarily at the same point). This may not only lead to seemingly unrelated end products in closely related plants, but also makes the establishment of plesiomorphic and apomorphic states difficult to detect. Such evolution would not be step wise, irreversible and dichotomous as required for use in cladistics. Despite this, chemical data have been successfully used to solve complex taxonomic problems, validate suspected relationships and bring to light totally unsuspected relationships at all levels of the taxonomic hierarchy (Culham & Gornall, 1994; Fraser *et al.*, 1995; Radford, 1986; Scogin, 1992 and; van Wyk & Whitehead, 1990). They are also useful for detecting species of hybrid origin, and for investigating inter and infra population variation. Chemicals also provide data sets independent of morphology. Some workers have seen this as an advantage, while others are concerned that patterns exhibited by structure often don't correlate with chemical patterns (Aparecida *et al.*, 1977).

Types of chemicals are seemingly endless and so can be used to generate many characters. The abundance of chemical characters has made them ideal for use in pattern recognition computer software; such as phenetics and cladistics. However, chemistry does not always prove to be taxonomically useful. The mixed success of chemical results has lead some (Heywood, 1973) to question its validity as an important source of taxonomic data.. However, there is little doubt about the positive contribution chemotaxonomy has made to our understanding of the classification and evolution of the plant world.

Macromolecules

Inorganic compounds are of limited taxonomic use. Organic compounds are most useful and can be divided into two main types — micromolecules and macromolecules; these latter sometimes called semantides (Jones & Luchsinger, 1987). From about the 1960s macromolecules began to take over from micromolecules as the most important source of chemical data. At first these macromolecular studies involved mainly proteins (Martin & Dowd, 1991), which were studied using electrophoresis or serology (Léone, 1962). Enzyme studies, in particular, formed a focal point (Hurka, 1980). However, as the understanding of RNA and DNA grew the use of the genetic material took over from proteins as the next and probably most basic source of taxonomic data (Soltis & Soltis, 1995). Being the ultimate source of most variation and the chemical basis of evolution, it is on the genome that most chemotaxonomy now focuses. DNA & RNA has largely replaced the use of micromolecules and proteins in taxonomic and evolutionary studies. Even genome size has been used taxonomically (Bennett & Leitch, 1995). Our understanding of nucleic acids has been paralleled by the development of new techniques such as PCR and later RAPDS (Jones et al., 1997). As a result, the 1990s has seen the mushrooming of the use of RNA and DNA data in systematics, either as "finger prints" or base pair sequence data (Dean & Scmidt, 1995). The mapping of genes is now being undertaken world wide, however, it had modest beginnings when Mendel mapped seven unlinked loci in six of the seven chromosome of the pea in 1865 (Innes, 1995).

The techniques involved in gene sequencing take time to master and the chemicals are expensive. As a result, taxonomic Ph.D. theses have either tended to opt for pure

taxonomic treatments with the use of less expensive and time consuming techniques or have concentrated on these RNA & DNA data at the expense of more orthodox data. Because of the time and expense of DNA studies, and also the need to increase the sample base, many workers have begun to opt for mass collaborative approaches to molecular systematics and phylogeny (Chase *et al.*, 1993). However, there are many problems surrounding the use of DNA data. We still do not know enough about how DNA behaves, not only during its own life-cycle, but also over long periods of time (Newton & Andrivon, 1995). Høj & Fincher (1995) suggest that after the development of the ozone layer organisms evolved diverse strategies to generate adaptive variation due to the slow down of point mutations; which they say was the main source of evolutionary change prior to this. Alternative strategies that bring about evolutionary change include exon shuffling or the movement of transposable elements. How these evolutionary modes are reflected in, or even skew, DNA results is not fully understood. In particular, issues surrounding the convergence of base pair sequences is a problem. However, homoplasy is a problem common to all types of characters, including morphology and micromolecules. Attempts have been made to resolve problems of "false similarity" in chemical data using cladistics (Williams, 1993). Other problems include the lateral transfer of genes. Even if such events occur only once in ten million years for every species, this means that over a period of 60 million years six genes would have been transferred in this way. Such events will cause havoc in tracing phylogenies and establishing similarity. Nuclear ribosomal DNA has, however, been successfully used to trace reticulate gene flow and evolution in *Paeonia* (Sang et al., 1995). The significance of genetic redundancy (Pickett & Meeks-Wagner, 1995) is still being investigated. Up to 90% of the genetic material in any one cell may be redundant or copy DNA. Also our understanding of the role played by introns and codons in the evolutionary process (Sharp & Matassi, 1994) is still at its infancy. Although much is known about the regulation of chloroplast gene expression (Mayfield, 1995), chloroplast DNA may evolve quite differently to nuclear DNA, in particular, what is taken for phylogeny may actually be tokogeny. Under such circumstances nuclear and chloroplast genes may suggest quite different phylogenies for the same group (Soltis & Kuzoff, 1995). As a result, nuclear DNA is now being more widely used than plastid DNA (Bachmann, 1992). Sequence data also requires the use cladistic or phenetic

programs to achieve any meaningful result. Cladistics in turn has its own set of inherent problems including only being able to reflect dichotomous evolution. Given all these unanswered questions and the limited sample size used in most studies, molecular systematists should be cautious about making sweeping taxonomic changes based on this data; an all too frequent occurrence. However, all the above problems should not detract from what is probably the most important source of taxonomic data discovered this century.

Micromolecules

These can be of two types depending on their importance to the functioning of plants; viz.: primary metabolites and secondary metabolites. Primary metabolites form part of vital metabolic processes and pathways and, as a result, are usually of universal occurrence, or at least widespread; such as citric acid which is part of the Krebs Cycle and so found in all aerobic organisms (Stace, 1989). As a consequence, the presence or absence of primary metabolites are generally of little taxonomic value. Only the quantities at which they occur (especially if they are storage material) might prove to be diagnostically useful; as in the family Rutaceae which accumulates large quantities of citric oils in its leaves.

Secondary metabolites are secondary plant products which usually perform non-vital functions, or vital functions of limited occurrence. They are not as widespread as primary metabolites, and it is this limited occurrence that makes these chemicals of taxonomic importance. In particular, they have been successfully used in the macrosystematics of the Magnoliophyta (Cronquist, 1977 and Gershenzan & Mabry, 1983). However, it is difficult to pin-point or establish if secondary metabolites have a function and what that function is. Without knowing their function it is impossible to establish if they are adaptive characters, or to assess just how heavily they have been selected for or against by environmental factors. However, it would seem, from experimentation, that secondary metabolites are waste products, food storage products, pigments, defensins (defensive chemicals), aromatics (scents) or structural material.

Types of secondary metabolites commonly found in the Apocynaceae:

Chemicals such as flavonoids are often called phenolics. This is a loose category of chemicals based on the possession of the phenol ring [C_6H_5OH]. Phenolics have a wide range of functions from pigments to mycosides and are widely found in the plant kingdom. They have proved of taxonomic importance (Groenewald *et al.*, 1986 & 1989).

a) Flavonoids — It has been estimated that 2% of all carbon fixed by photosynthesis is converted into flavonoids or related compounds (Markham, 1982). These have been widely and effectively used in both taxonomic and evolutionary studies (Gornall & Bohm 1978; Ishikura, 1979; Ishikura & Sugahra, 1979; Stevens *et al.*, 1995 and; van Wyk, 1995), they have also been used in infraspecific studies (Bohm, 1987); even being used to distinguish diploid from tetraploid plants (Harborne, 1973). Flavonoids are of wide occurrence, easily extracted, isolated and identified, only small quantities of plant material are required, they are chemically stable, they can be used at all taxonomic levels, they are simple to use and the results are effective. They also have great structural variety (over 2000 types are known). Some are of economic importance (Dakora, 1995). This structural variety correlates well with morphological and genetic variation. However, flavonoids don't always produce conclusive results.

b) Terpenoids — Over 22 000 types are known. They include some plant hormones (e.g. gibberellins and abscisic acid), some photosynthetic pigments (carotenoids) and cell membrane components (phytosterols). They are also used in communication (pollinator attractants) and defense (McGarvey & Croteau, 1995). Some are medicinally important, such as the sweetness inhibitors found in the asclepiad *Gymnema sylvestre* R. Br. (Suttisri *et al.*, 1995) and cucurbitacin found in some marrows (Miró, 1995). Terpenoids have been used effectively in those groups where they occur. Unfortunately, they are of limited distribution, and elucidation of their structure requires expensive equipment and lot of expertise. Their benefits are that they can be used to distinguish entities as low as geographical races, and are also useful in phylogenetic and biogeographical studies. The genetic basis of terpenoids still has to be thoroughly investigated. Interestingly terpenoids have even been found in the leaves of *Hoya* R. Br. (Baas & van Berkel, 1991), possibly these act as antibacterial, antivirals or mycosides. These chemicals rival the alkaloids in their defensive potency (and may even exceed

them) and diversity. The Asteraceae, which has many extremely poisonous plants including the infamous *Senecio* L., has over 3000 different sesquiterpene lactones (Robles *et al.*, 1994).

c) Alkaloids — These are an economically important group of substances. They are used as poisons (e.g. strychnine), for the production of medicines (e.g. morphine and taxol), industrial chemicals and as stimulants (e.g. caffeine and cocaine). Over 10 000 types are known (Lewis, 1993; Michael, 1995; Plunkett, 1994 and; Southon & Buckingham, 1989). Alkaloids are a complex and difficult group of chemicals to work with. They are also structurally and biosynthetically complicated, however, they have been used effectively in solving many taxonomic problems. In particular, the family Fabaceae in southern Africa has been particularly well investigated (van Wyk *et al.*, 1988; van Wyk *et al.*, 1989 and; van Wyk & Verdoorn 1989). It is this group of chemicals that the Apocynaceae are most well known for. In this family alkaloids are mostly of the indole (Saxton 1995), phenanthro-indolizine and pyridine types. The medicinally important *Catharanthus roseus* (L.) G. Don. contains over 100 different monoterpenoid indole alkaloids (Kutchan, 1995). The family has evolved a wide array of alkaloids, many of them as defensins that are used to protect plants from predation and infection (Coporale, 1995). These include stophanthinidin (which is used as an arrow poison) and cardioglycosides for which the family is well known. Cardioglycosides or cardinolides work on the heart muscles of animals, causing it eventually to stop beating. A number of insects are able to feed on asclepiads and accumulate these poisons to use in their own defense. Members of the Danaed butterflies (which includes the African Monarch) being the most well recorded (Harborne, 1982 & Hartmann, 1991). Thin Layer Chromatography has even been done on monarch butterflies and matched against their larval host-plant (Martin *et al.*, 1992). Despite their toxicity, humans have exploit these compounds. The stem-tuber of *Xysmalobium undulatum* (L.) W.T. Aiton is widely used in Europe, under the name *uzara*, as a treatment for acute diarrhoea (Schmitz *et al.*, 1992). In southern Africa it is also used for dysentery, diarrhoea, dyspepsia, indigestion and as a uterine sedative (Brandwijk, 1927). However, the active ingredient(s) has/have not yet been isolated.

d) Iridoids — These have been recorded in the group (Abe *et al.*, 1995)

d) Latex — This is almost universal in the family and contains rubber which is sometimes produced in large quantities.

e) Chemical Groups that are Conspicuously Absent — Naphthaquinones and aucubin glycosides have so far not been reported from the Apocynaceae.

Cardinolides

Also known as cardioglycosides, cardinolide glycosides or cardiotonic glycosides. These chemicals are characterised by having a sugar moiety attached to a steroid nucleus through bonding with hydroxyl groups on both C-2 and C-3 positions of the aglycone, or glycosidation may occur at C-3. Interestingly, many of the sugar molecules involved are only known to occur in these chemicals and are not found free or in combination with other chemicals. Cardinolides have arisen independently a number of times in families as diverse and unrelated as the Liliaceae (Jäger & van Staden, 1995), Moraceae and Ranunculaceae (Gibbs, 1974). Over 50 types of cardinolides have been identified in the subfamily Asclepiadoideae. The main function of cardioglycosides is in defense against herbivory by animals (Seiber *et al.*, 1983). Principally they inhibit Na^+, K^+-atpase in cardiac muscle. In mammals, poisoning includes profuse depression accompanied by staggering. Collapse follows as does laboured respiration, elevated temperature, pupil dilation and finally death (Cheeke & Shull, 1985). Many asclepiads have been reported as the cause of stock loss, including the succulent leafless genus *Sarcostemma viminale* (L.) R. Br. High quantities of cardinolides have been found in seeds of *A. curassavica* L. (Abe *et al.*, 1992) and presumably play a part in protecting these especially nutritious propagules from being eaten. In spite of their apparent toxicity many asclepiads are eaten, or taken for medicinal purposes. The root of *X. undulatum* (already mentioned) for diarrhoea; the root of *Calotropis gigantea* (L.) W.T. Aiton is used in Indonesia as an antidote for snakebite and as an anti-scabetic (Shibuya *et al.*, 1992); root extract from *Calotropis procera* (Aiton) W.T. Aiton has some promise as an antiinflammatory and analgesic (Basu & Chaudhuri, 1991); leaf extracts of *Gymnema sylvestre* R. Br. is used in India to treat diabetes (Srivastava *et al.*, 1986); extracts from *Araujia sericofera* Brot. has been shown experimentally to have analgesic and antiinflammatory properties, with the

advantage of lacking the ulcerogenic activity of substances like aspirin (Bello *et al.*, 1995).

Many different kinds of cardioglycosides have been extracted from both the apocynoids (Abe & Yamauchi, 1997) and asclepiads. Genera that have been investigated within the Asclepiadoideae and which have tested positive for cardioglycosides include, amongst others: *Asclepias* L. *sensu* Nicholas *et al.* (in press) (Abe *et al.*, 1991), *Gomphocarpus* R. Br. (El-Askary *et al.*, 1995 and Warashina & Noro, 1994a & 1994b), *Tylophora* R. Br. (Abe *et al.*, 1995), *Cynanchum* L. (Steyns *et al.*, 1989); *Sarcostemma* R. Br. (Vleggaar *et al.*, 1993); *Calotropis* R. Br. (Shibuya *et al.*, 1992). A more expanded list is given in Gibbs (1974).

Chemical Patterns in the subfamily Asclepiadoideae

Unfortunately, the sample size is still too small to make conclusions that may hold to be true for the entire subfamily. The problem is made more difficult by the fact that generic delimitation is still in flux (Nicholas, 1989). A brief survey of the occurrence of chemicals in the subtribe Asclepiadinae (based on Gibbs, 1974 and other sources mentioned in this paper), by genera, are given in table 1.

Table 1. Chemicals found in the Asclepiadoideae

Chemical	**Genus**
Acetyl-odorogenine-B (Acetyl-uzarigenin)	*Xysmalobium*
Afroside-B	*Gomphocarpus*
Calotropagenin	*Calotropis*
Calactin	*Calotropis*
Calotoxin	*Calotropis*
Calotropin	*Asclepias, Calotropis*
Ascotuberoside	*Asclepias*
Uzarigen	*Gomphocarpus, Pachycarpus, Xysmalobium*
Caroglaucigenin (uzarigen-19-01	*Gomphocarpus, Xysmalobium, Calotropis*
Carotoxigenin (19-oxo-uzarigenin)	*Gomphocarpus, Calotropis*

Fugoside	*Gomphocarpus, Xysmalobium, Calotropis*
Uzarigenin	*Gomphocarpus, Xysmalobium, Pachycarpus*
Cymarin (K-strophanthen-α)	*Pachycarpus*
Pachygenin	*Pachycarpus*
Pachygenol	*Pachycarpus*
Gofruside/Gomphoside	*Gomphocarpus*
Urezigenin	*Xysmalobium*
Urezin	*Xysmalobium*
Xymalogenin	*Xysmalobium*
Uzaroside	*Xysmalobium*
Xysmalarin	*Xysmalobium*
Xysmalogenin	*Xysmalobium, Pachycarpus*
Quercetin-3-galactoside	*Calotropis* (also *Hemidesmus, Leptadenia, Marsdenia, Pergularia* and *Telosma)*

Several chemicals show what could be a phylogenetic link between the more basal members of the subtribe Asclepiadinae in southern Africa, viz. fugoside, uzarin, 19-oxo-uzarigenin, uzarigen-19-01 and xysmalogenin connect *Calotropis*, *Xysmalobium*, *Pachycarpus* E. Mey. and *Gomphocarpus*. Based on morphological data, these genera are all clearly related (Nicholas *et al.* and Nicholas & Baijnath, in press). Interestingly, *Calotropis* is chemically linked to *Hemidesmus* R. Br., *Leptadenia* R. Br., *Pergularia* L., *Telosma* Colville and *Marsdenia* R. Br. by quercetin-3-galactoside. *Telosma* and *Marsdenia* are related and the presence of this chemical may suggest they evolved from a common ancestor with *Calotropis*. If quercetin-3-galactoside is found in *Dregea* E. Mey. it may help confirm this and would explain the winged fruit of this genus, a character common in the basal members of the Asclepiadinae (e.g. *Pachycarpus*).

Techniques

The use of micromolecules only became widely used by taxonomists with the advent of chromatography, which was developed for use by botanists in the 1940s. Chromatography is actually a variety of different techniques, all using the molecules own chemical and physical properties to separate it from other molecules (Phillipson, 1995). Physical properties used in chromatography include: adsorption (the tendency of a molecule to become attached to a solid), solubility (the tendency of a molecule to

dissolve in a liquid) and volatility (the tendency of a molecule to evaporate). Types of interaction used include: partition (the tendency of a substance to distribute itself between two non-mixing liquids, a liquid and a solid or a liquid and a gas), movement (a moving phase passing over a stationary phase combined with the fact that chemicals move at different rates), and attraction or polarity (molecules have different degrees of attraction to other molecules). Different types of chromatography are based on the use of different physical properties and kinds of interaction outlined above. Thin Layer Chromatography (TLC) was used for this study and is a combination of partition and absorption taking place together. TLC consists of a mobile liquid phase moving over an adsorbent gel surface which supports a water phase. Different plant chemicals separate out in bands depending on their properties, especially their degree of polarity. These bands are then made visible with the use of reagents. Either one dimensional separation or a two dimensional separation can be done. The ratio obtained by dividing the distance moved by the substance/chemical by the distance moved by the solvent is called the *Rf* value and this can be calculated for each chemical band that separates out. The *Rf* value is considered to be a property of the chemical involved. The chemical bands can also be eluted out and analyzed for its chemical structure. A number of methods exist for the extraction of secondary metabolites (Toti *et al.*, 1995).

Problems with Using Chemical Data

As with all techniques, there are some problems involved with the use of chemical data:

1) Negative results are often not published, unfortunately these are as important as positive results. Because these negative results are not published, taxonomists are deprived of valuable diagnostic data.
2) Chemical finger prints are difficult to use in diagnostic keys.
3) Taxonomists are inclined to think of chemical data as more important than morphological data, and so give it more weight. There is, however, no proof to support this contention. In fact, sometimes morphological data turns out to be taxonomically more important than chemical data and sometimes the reverse, viz. one source of data is not necessarily more important than another.

4) Both chemical and morphological characters are expressions of the genotype, and are thus both equally prone to the same kinds of problems, especially that of variation, parallelism and convergence.

This study

Although a great deal of work has been done on the chemistry of the Asclepiadoideae, this has largely concentrated on elucidating individual molecular structure, especially those of commercial or medical importance. These studies have chiefly involved Asian species: *Cynanchum vincetoxicum* (L.) Pers. (Iwasa *et al.*, 1993), *Sarcostemma brevistigma* Wight & Arnott (Khare *et al.*, 1987); *Tylophora tanakae* Maxim. ex Franch. & Sav. (Abe *et al.*, 1995), *Hoya naumanii* Schltr. (Baas & van Berkel, 1991) and *Marsdenia globifera* Tsiang (Sheng-Xiang, 1990). In particular, *Cynanchum hancokianum* (Maxim.) Al. Iljinski has, because of its reported antitumour activity, been a focal point of research (Kondo *et al.*, 1990 and Lou *et al.*, 1991). Few studies have been carried out on African species: *Cynanchum africanum* R. Br. (Steyn *et al.*, 1989), *Gomphocarpus fruticosus* (L.) W.T. Aiton (Warashina & More, 1994a & 1994b), *G. sinaicus* Boiss (El-Askary *et al.*, 1995) and *Xysmalobium undulatum* (Brandwijk, 1927 and Schmitz *et al.*, 1992). Albeit, a few species, such as *Calotropis gigantea* (Shibuya *et al.*, 1992), *C. procera* (Basu & Chaudhuri, 1991), *Gymnema sylvestre* (Srivastava *et al.*, 1986) and *Sarcostemma viminale* (Vleggaar *et al.*, 1993), span both Asia and Africa. The chemistry of North American species have largely been investigated in connection with population and species dynamics (Broyles & Wyatt, 1993, Wyatt & Hunt, 1991 and Wyatt & Broyles, 1992) or as a taxonomic aid (Seiber *et al.*, 1983). Efforts have been made to elucidate the chemistry of the Central American species *Asclepias curassavica* (Abe *et al.*, 1991 & 1992) and the South American species *Araujia sericofera* (Bello *et al.*, 1995); both have, interestingly, become troublesome weed in many warm countries outside of the New World.

With over 180 species and 23 genera we have opted to use micromolecules, rather than macromolecules to study the chemical patterns and profiles produced by secondary metabolites in the Asclepiadinae of southern Africa. However, during field work DNA samples were also collected (dried using the silica gel technique) and these have been

sent to Dr. Sigrid Liede at Bayreuth University in Germany. At some latter date (when a representative sample has been obtained) it is hoped that, in conjunction with these overseas workers, that we can produce a molecular DNA study for the subtribe. In this study we were concerned only with the patterns formed (the chemical "finger print" or profile) by the secondary metabolites. As a result, only one dimensional chromatography was used and chemical structure not analysed. With over 60 samples (representing 39 species in 17 genera) and hundreds of bands produced we have not calculated *Rf* values. Also, *Rf* values can be difficult to reproduce. They are often a reflection of the skill of the experimenter, subject to variations relating to the surrounding environment and even dependent on the quality of TLC plate.

Besides investigating the chemical profiles of individual species we have also looked at population variation (i.e. infraspecific variation), within-plant variation and generic variation. To help with comparative and phylogenetic discussion we have also included species from other subtribes (*Pentarrhinum* E. Mey. from the Cynanchinae), tribes (*Anisotoma* Fenzl. from the Stapelieae) and subfamilies (*Raphionacme* Harv. from the Periplocoideae), and also two non African species (*Asclepias curassavica*, from Central America, and *Araujia sericofera*, from South America). As will be discussed later, these chemical profiles have proved to be of taxonomic significance at both the specific and generic levels. Voucher specimens were collected for all species sampled (table 2) and these are housed at the Ward Herbarium (UDW).

Table 2. List of Voucher Specimens and Localities (all vouchers housed at the Ward Herbarium [UDW])

Chromatogram Number	Species	Collector & Numbers	Locality of Collection
1	*Xysmalobium stockenstromense*	Nicholas2719 with Poorun	KwaZulu-Natal, Nottingham Road
2	*Xysmalobium stockenstromense*	Nicholas 2731 with Poorun	KwaZulu-Natal, Sunset farm, nr. Underberg
3	*Xysmalobium undulatum*	Nicholas 2780 with DC Nicholas	Free State, near Zastron
4	*Xysmalobium undulatum*	Nicholas 2727 with Poorun	KwaZulu-Natal, Byrne
5	*Xysmalobium undulatum*	Nicholas 2830 with DC Nicholas	Eastern Cape, near Komga
6	*Gomphocarpus fruticosus*	Nicholas 2781 with DC Nicholas	Free state, Zastron — Sterkspruit
7	*Gomphocarpus fruticosus*	Nicholas 2768 with Poorun & Govender	KwaZulu-Natal, Loteni
8	*Gomphocarpus fruticosus*	Nicholas 2775 with DC Nicholas	Free State, near Bloemfontein
9	*Gomphocarpus fruticosus*	Nicholas 2782 with DC Nicholas	Eastern Cape, near Maclear
10	*Gomphocarpus fruticosus*	Nicholas 2779 with DC Nicholas	Free State, near Zastron
11	*Gomphocarpus fruticosus* (leaves)	Nicholas 2796 with DC Nicholas	Eastern Cape, near Seymour
12	*Gomphocarpus fruticosus* (flowers)	Nicholas 2796 with DC Nicholas	Eastern Cape, near Seymour
13	*Gomphocarpus physocarpus*	Nicholas 2787 with DC Nicholas	KwaZulu-Natal, Harding — Padock
14	*Gomphocarpus physocarpus*	Nicholas 2829 with DC Nicholas	Eastern Cape, Kei Mouth — Komga
15	*Gomphocarpus physocarpus*	Nicholas 2879 with DC Nicholas	KwaZulu-Natal, Tidbury's Toll
16	*Pachycarpus dealbatus*	Nicholas 2764 with Poorun & Govender	KwaZulu-Natal, Loteni
17	*Pachycarpus schinzianus*	Nicholas 2793 with Baijnath & Singh	Gauteng, near Suikkerbossierand
18	*Pachycarpus concolor*	Nicholas 2789 with Poorun	KwaZulu-Natal, Vernon Crooks
19	*Pachycarpus sp*	Nicholas 2763 with Poorun & Govender	KwaZulu-Natal, Loteni.
20	*Pachycarpus plicatus*	Nicholas 2732 with Poorun	KwaZulu-Natal, Sunset farm nr. Underberg

21	*Pachycarpus grandiflorus*	Nicholas 2724 with Poorun	KwaZulu-natal, near Byrne
22	*Pachycarpus coronarius*	Nicholas 2812 with Dold	Eastern Cape, Grahamstown
23	*Pachycaris albens*	Nicholas 2791 with Poorun	KwaZulu-Natal, Vernon Crooks
24	*Pachyacris albens*	Nicholas 2723 with Poorun	KwaZulu-Natal, near Byrne
25	*Pachyacris albens*	Nicholas 2813 with DC Nicholas	Eastern Cape, Martindale area
26	*Pachyacris albens*	Nicholas 2813 with DC Nicholas	Eastern Cape, near Martindale
27	*Pachyacris macropus*	Nicholas 2717 with Poorun	KwaZulu-Natal, near Nottingham Road
28	*Pachyacris flexuosa*	Without voucher	Unknown
29	*Pachyacris multicaulis*	Nicholas 2726 with Poorun	KwaZulu-Natal, near Midmar
30	*Pachyacris multicaulis*	Nicholas 2733	KwaZulu-Natal, Sunset farm nr. Underberg
31	*Pachyacris woodii*	Nicholas 2728 with Poorun	KwaZulu-Natal, Howick
32	*Pachyacris parviflora* (stems)	Nicholas 2762 with Poorun & Govender	KwaZulu-Natal, Kamberg
33	*Pachyacris parviflora* (leaves)	Nicholas 2762 with Poorun & Govender	KwaZulu-Natal, Kamberg
34	*Pachyacris parviflora* (flowers)	Nicholas 2762 with Poorun & Govender	KwaZulu-Natal, Kamberg
35	*Aidomene revoluta*	Nicholas 2748 with Poorun	KwaZulu-natal, Sani Pass
36	*Aidomene revoluta*	Without voucher	unknown
37	*Aidomene cucullata*	Nicholas 2758 with Poorun & Govender	KwaZulu-Natal, Kamberg
38	*Aidomene cucullata*	Nicholas 2752 with Poorun & Govender	KwaZulu-Natal, Giant's Castle
39	*Aidomene cucullata*	Nicholas 2747 with Poorun	KwaZulu-Natal, Sani Pass
40	*Aidomene humilis*	Nicholas 2759 with Poorun & Govender	KwaZulu-Natal, Kamberg
41	*Sigridia cultriformis*	Nicholas 2729	KwaZulu-Natal, Sunset farm nr. Underberg
42	*Stenostelma involucratum*	Nicholas 2802 with DC Nicholas	Eastern Cape, Happy Valley
43	*Stenostelma involucratum*	Nicholas 2742 with Poorun	KwaZulu-Natal, Dukuduku
44	*Stenostelma involucratum*	Nicholas 2761 with Poorun & Govender	KwaZulu-Natal, Kamberg

45	*Periglossum mackenii*	Nicholas 2718 with Poorun	KwaZulu-Natal, near Nottingham Rd
46	*Bruynsia gibba*	Nicholas 2778 with DC Nicholas	Free State, Bloemfontein — Ficksburg
47	*Araujia sericofera*	Nicholas 2785 with DC Nicholas	KwaZulu-Natal, Harding
48	*Bruynsia eminens*	Nicholas 2794 with Baijnath & Singh.	Gauteng, near Suikkerbossierand
49	*Bruynsia gibba*	Nicholas 2795 with Baijnath & Singh.	Gauteng, near Suikkerbossierand
50	*Bruynsia disparilis*	Nicholas 2784 with DC Nicholas	KwaZulu-Natal, near Harding
51	*Woodia mucronata*	Nicholas 2809 with Dold	Eastern Cape, Grahamstown
52	*Schizoglossum bidens* subsp. *pachyglossum*	Nicholas 2720 with Poorun	KwaZulu-Natal, Nottingham Rd-Dargle
53	*Schizoglossum bidens* subsp. *pachyglossum*	Nicholas 2722 with Poorun	KwaZulu-Natal, near Byrne
54	*Schizoglossum bidens* subsp. *pachyglossum*	Nicholas 2735	KwaZulu-Natal, Sunset farm nr. Underberg
55	*Schizoglossum bidens* subsp. *pachyglossum*	Nicholas 2730 with Poorun	KwaZulu-Natal, Nottingham Rd — Dargle
56	*Schizoglossum bidens* subsp. *pachyglossum*	Nicholas 2725 with Poorun	KwaZulu-Natal, near Byrne
57	*Schizoglossum flavum*	Nicholas 2757 with Poorun & Govender	KwaZulu-Natal, Kamberg
58	*Schizoglossum linifolium*	Nicholas 2783 with DC Nicholas	KwaZulu-Natal, Harding — Weza
59	*Asclepias curassavica*	Nicholas 2738 with DC Nicholas	KwaZulu-Natal, Amanzimtoti
60	*Pentarrhinum insipidum*	Ward	KwaZulu-Natal, Durban
61	*Anisotoma cordifolia*	Nicholas 2811 with Dold	Eastern Cape, Grahamstown
62	*Tylophora flanaganii*	Nicholas 2839 with Nichols	KwaZulu-Natal, Durban
63	*Raphionacme hirsuta*	Nicholas 2741 with Poorun	KwaZulu-Natal, Dukuduku
64	*Raphionacme palustris*	Nicholas 2740 with Poorun	KwaZulu-Natal, Dukuduku
65	*Raphionacme galpinii*	Nicholas 2739 with Poorun	KwaZulu-Natal, Dukuduku

Materials and Methods

The method used was largely that outlined by Carr and Rogers (1987). Plant samples were weighed and this weight recorded. Voucher specimens were also made (table 2). Polar compounds were extracted by placing leaves, stems or flowers (separately) into absolute methanol overnight at room temperature. The methanol, now containing the metabolites and water, was then decanted from the plant remains which were then discarded. The water and methanol was then removed by using a rotary evaporator and finally placed in a temperature controlled vacuum oven. The dried residue obtained was then stored in a refrigerator at -20°c until needed for use. For spotting, 50mg of each residue was weighed out and made into a solution using 1ml of 1:1 V/V $CHCl_3$:ethanol. Only metabolites that could dissolve in this solvent were of concern to us, others may remain in the undissolved residue. This solution was then spotted onto Merck silica gel GF_{254} plates in bands 10mm wide (in 2 applications) and allowed to develop by ascending chromatography for 90mm. These chromatograms were run in three different solvent systems with differing abilities to separate out polar chemicals. The first of these solvent systems was a mixture of 8:3 V/V [hexane (light petroleum spirit): ethyle acetate] known as the 80/30 solvent. This solvent system moves the least polar chemicals. The second solvent system used was 5:5 V/V [80/30:Acid mixture - see next] known as the 50/50 solvent. This solvent system moves moderately polar compounds. The final solvent system was a mixture of chloroform, ethyl acetate and formic acid combined in ratios of 5:4:1 V/V [$CHCl_3$:EtOAc:HCO_2H] known as the Acid solvent. This solvent system moves the most polar compounds.

For spot detection a spray reagent consisting of p-anisaldehyde (5ml), conc. H_2SO_4 (5ml) and ethanol (90ml) was sprayed onto the plates which were then placed for two to five minutes into a oven heated to 110°c. This reagent reacts with reactive functionalities such as double bonds and hydroxy functions. The "developed" plates were then digitised using a computer and scanner. Before spraying, photosynthetic and other visual pigments were also scanned. Images were saved in *tiff* file format.

RESULTS

See figures 1 to 6. Species were spotted as numbers 1 to 65; as outlined in table 3.

DISCUSSION

In pigment profile, greens are chlorophylls, while oranges, yellows or browns are xanthophylls or carotenoids. In plates sprayed with reagent, pink, bright blue and mauve bands are usually triterpenoids, sterols, esters, fatty acids and alkaloids such as cardioglycosides. Dull browns are usually ketones. Compounds containing alcohols often produce brighter spots. Many compounds, especially small aromatic ones, don't show up on the chromatograms, however, these can be seen using ultra violet light. Unfortunately, it is difficult to record these results and this avenue was not pursued in this study. The results are discussed below according to solvent system. Species numbers are given in square brackets.

Visual Pigments

Pigment profiles of *Xysmalobium*, *Pachycarpus*, *Aidomene* Stopp, *Bruynsia* Nicholas, *Stenostelma* Schltr., *Woodia* Schltr. and *Schizoglossum* E. Mey. are all similar. Morphologically *Xysmalobium* and *Pachycarpus* are certainly related, as are *Bruynsia* and *Stenostelma*. However, in *Bruynsia* some of the upper middle bands are absent as they are in *Pachyacris* Schltr. ex Nicholas & Goyder. To some extent *Pachyacris* and *Pentarrhinum insipidum* E. Mey. also have a similar profile, but many of the upper middle, mostly brown and grey, bands are absent. Interestingly, the South American species *Araujia sericofera* [47] also has a similar pattern. *Sigridia cultriformis* (Harv. ex Schltr.) Nicholas has a simpler profile when compared to *Xysmalobium* and allies, but one which is somewhat similar to that of *Gomphocarpus*; which, interestingly, it seems most related to (Nicholas *et al.*, in press). *Periglossum mackenii Harv.*, *Tylophora flanaganii* Schltr. and *Asclepias curassavica* are almost devoid of pigments; problems with *Tylophora flanaganii* are discussed later. *Raphionacme*, from the subfamily Periplocoideae shows a quite different pigment pattern with pigments in the middle section, but these lacking in the lower and upper portions of the plate. Individual species

Table 2. Species Key To Numbers on Chromatograms

1	*Xysmalobium stockenstromense*
2	*Xysmalobium stockenstromense*
3	*Xysmalobium undulatum*
4	*Xysmalobium undulatum*
5	*Xysmalobium undulatum*
6	*Gomphocarpus fruticosus*
7	*Gomphocarpus fruticosus*
8	*Gomphocarpus fruticosus*
9	*Gomphocarpus fruticosus*
10	*Gomphocarpus fruticosus*
11	*Gomphocarpus fruticosus* (leaves)
12	*Gomphocarpus fruticosus* (flowers)
13	*Gomphocarpus physocarpus*
14	*Gomphocarpus physocarpus*
15	*Gomphocarpus physocarpus*
16	*Pachycarpus dealbatus*
17	*Pachycarpus schinzianus*
18	*Pachycarpus concolor*
19	*Pachycarpus sp.*
20	*Pachycarpus plicatus*
21	*Pachycarpus grandiflorus*
22	*Pachycarpus coronarius*
23	*Pachycaris albens*
24	*Pachyacris albens*
25	*Pachyacris albens*
26	*Pachyacris albens*
27	*Pachyacris macropus*
28	*Pachyacris flexuosa*
29	*Pachyacris multicaulis*
30	*Pachyacris multicaulis*
31	*Pachyacris woodii*
32	*Pachyacris parviflora* (stems)
33	*Pachyacris parviflora* (leaves)
34	*Pachyacris parviflora* (flowers)
35	*Aidomene revoluta*
36	*Aidomene revoluta*
37	*Aidomene cucullata*
38	*Aidomene cucullata*
39	*Aidomene cucullata*
40	*Aidomene humilis*
41	*Sigridia cultriformis*
42	*Stenostelma involucratum*
43	*Stenostelma involucratum*
44	*Stenostelma involucratum*
45	*Periglossum mackenii*
46	*Bruynsia gibba*
47	*Araujia sericofera*
48	*Bruynsia eminens*
49	*Bruynsia disparilis*
50	*Bruynsia gibba*
51	*Woodia mucronata*
52	*Schizoglossum bidens* subsp. *pachyglossum*
53	*Schizoglossum bidens* subsp. *pachyglossum*
54	*Schizoglossum bidens* subsp. *pachyglossum*
55	*Schizoglossum bidens* subsp. *pachyglossum*
56	*Schizoglossum bidens* subsp. *pachyglossum*
57	*Schizoglossum flavum*
58	*Schizoglossum linifolium*
59	*Asclepias curassavica*
60	*Pentarrhinum insipidum*
61	*Anisotoma cordifolium*
62	*Tylophora flanaganii*
63	*Raphionacme hirsuta*
64	*Raphionacme palustris*
65	*Raphionacme galpinii*

sometimes break the generalized pattern. *Pachycarpus schinzianus* (Schltr.) N.E. Br. for instance is almost devoid of pigments unlike the other *Pachycarpus* species, however, it without doubt belongs in *Pachycarpus* (Nicholas & Baijnath, in press). In the genus *Pachyacris*, extracts from the leaves of *P. parviflora* (Harv. ex Scott-Elliot) Stewart & Langley ex Nicholas & Goyder show more pigments than do the stem and flowers, in fact, the flower extracts are interestingly almost devoid of pigments. Interestingly, this reverses itself in the Acid solvent system. Quite a bit of intraspecific variation can also be seen, but this is discussed later (figs 1 & 2).

80/30 Solvent System

This solvent system moves the least polar substances. Generally these chemicals are smaller and the end products of less elaborate pathways (i.e. involving fewer enzyme mediated steps). As a result, they may be seen as predominantly plesiomorphic, although, no doubt, some may have evolved via reduction of once more complex pathways (i.e. reversals). These plates should elucidate more distant relationships. Many probably even pre-date the evolution of the family. It is not, thus, surprising that these plates have less spots.

Xysmalobium, *Gomphocarpus*, *Stenostelma*, *Bruynsia*, *Schizoglossum*, *Sigridia* Nicholas, *Asclepias*, and *Pentarrhinum* all have a similar pattern. *Pachycarpus* is like this group, but much more complex, in that it is similar to *Pachyacris* and *Aidomene*. *Periglossum* Decne. shows a very simple pattern with spots only in the upper ¼. *Woodia* [51] has a unique profile (although morphological data suggests that it should be similar to *Pachycarpus*), the lower ¾ being featureless, but with a brown, blue and dark brown spot in the upper ¼. In this it is somewhat similar to some *Bruynsia* profiles [e.g. 50]; to which it is probably distantly related. *Anisotoma* [61] and *Tylophora* [62] are almost devoid of spots, as in their pigment profiles. *Raphionacme* is similar to *Xysmalobium* and allies, but exhibits a few unique spots in the upper ⅓. Many spots are almost universal such as the blue line near the top of the plates This line shows spots of varying intensity, but no doubt represents the same chemical. This is to be expected in plesiomorphic characters (that is the premise that common is primitive) (figs. 2 & 3).

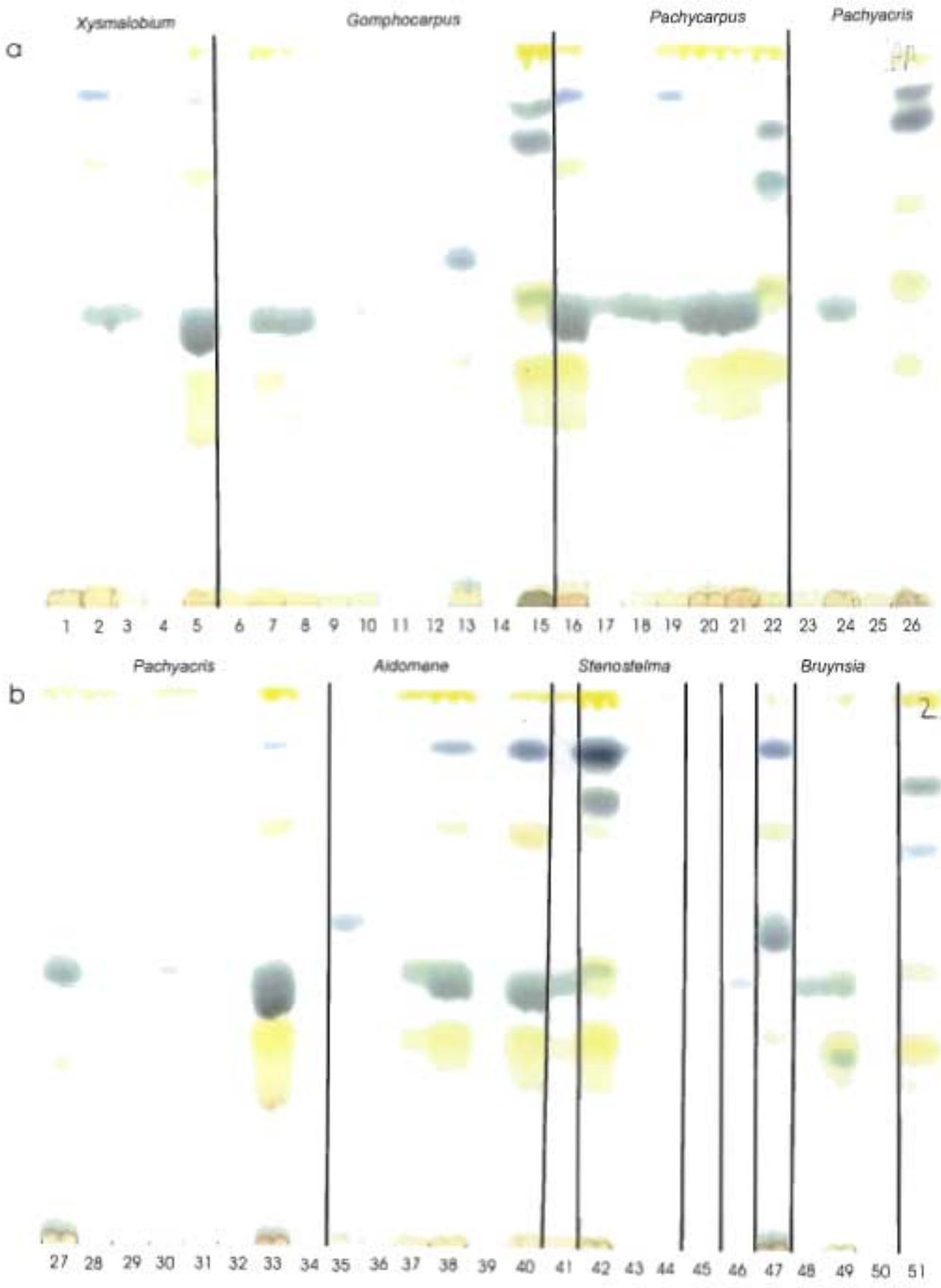


Figure 1. a. & b. Pigment profile results.

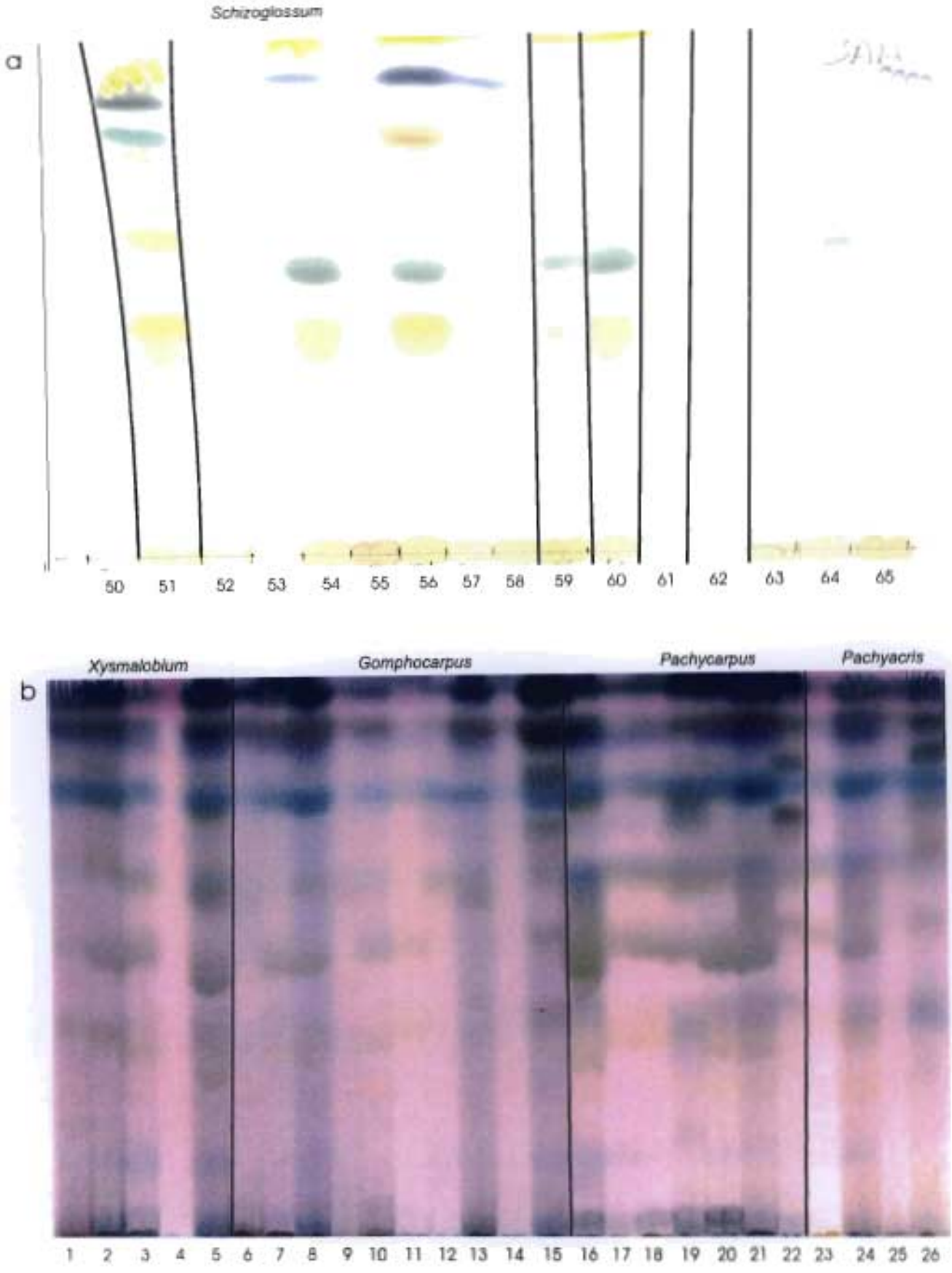


Figure 2. a. Pigment profile result. b. 80/30 solvent system result.

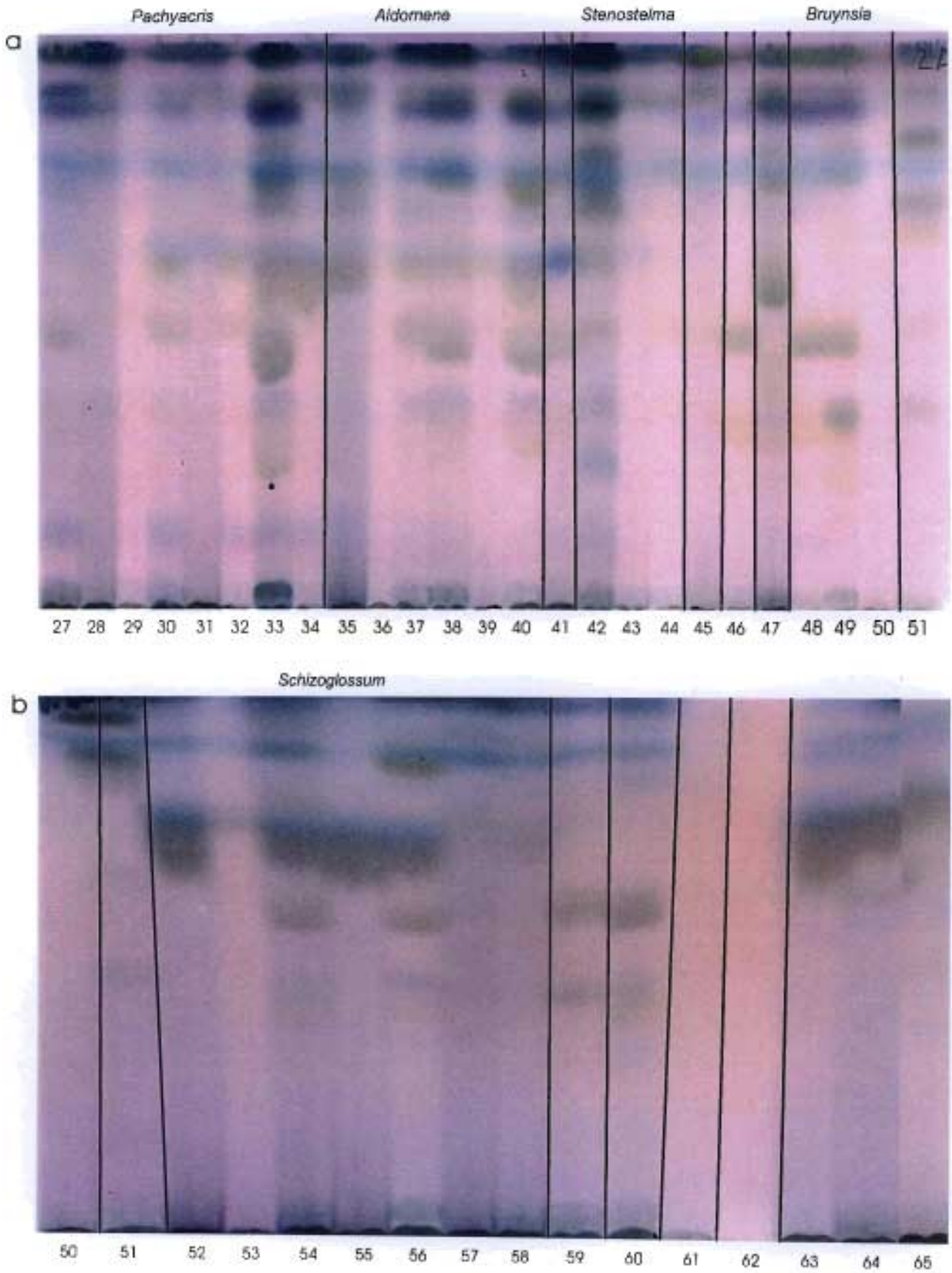


Figure 3. a. & b. Result of 80/30 solvent system.

50/50 Solvent System

This solvent system moves the next most polar set of chemicals. These are generally more complex. Plates placed in this solvent system begin to show the differences in individual species more clearly. Sample 5 [*X. undulatum*] shows great similarity to *Gomphocarpus* and *Pachycarpus*. This is what would be expected going by morphological similarity. However, samples 3 and 4 are also *X. undulatum*, and they show a quite different profile. A similar phenomenon can be seen in the four samples of *Pachyacris albens* (E. Mey.) Nicholas & Goyder [23, 24, 25 and 26]. Sample 23 shows two yellow spots near the plate base, sample 26 shows only one such yellowish spot, but samples 24 and 25 do not have these spots at all. Also 23 and 24 show a mauve- red spot near the profile base, but this is not seen in samples 25 and 26. All four specimens were collected at different localities and at different times of the year, and clearly reflect both population (infraspecific) and seasonal variations in the chemistry of this species. This is not surprising, as seasonal variation in secondary metabolites have been reported in North American species of *Asclepias* (Adams & Price, 1987). We have not come across other studies on population profiles in the same species for the Apocynaceae, but Wyatt & Broyles report that both flavonoid (1991) and isozyme (1992) evidence points to fairly extensive hybridization occurring between *Asclepias* species in North America. Because of this, Broyles & Wyatt (1993) have suggested that this has lead to fairly high levels of gene flow between populations and also between some species. Morphological evidence also indicates that such gene flow is quite prevalent in some southern African species (Nicholas *et al.*, in press). Such high levels of interspecific gene flow could possibly explain why the population profiles of some species vary greatly. Another explanation could also be isolation. Population of a species that has been isolated from other populations for long periods could begin to evolve unique chemical profiles. However, this is unlikely to be the case in the widespread and fairly common *P. albens*. *Stenostelma involucratum* (E. Mey.) Nicholas [samples 42 to 44] also have profiles that vary quite a lot, but none show unique coloured spots as does the populations of *P. albens*. Samples 52 to 56 are all of *Schizoglossum bidens* E. Mey. subsp. *pachyglossum* (Schltr.) Kupicha. Like those of *P. albens*, these were collected from different populations and at different times of the year. They show some variation in their profiles, but certainly nothing as

dramatic as seen in *X. undulatum* and *P. albens*. Population profiles of *Gomphocarpus fruticosus* [samples 6 to 12] and *G. physocarpus* [samples 13 to 15] remain fairly conservative so much so that the two species have profiles that cannot be separated. It has also been reported (Seiber *et al.*, 1983) that quantitative and qualitative chemical differences can be seen in different parts of the same plant. We have examined this too. Leaves [11] and flowers [12] of *G. fruticosus* show no differences, however, stems [32], leaves [33] and flowers [34] of *Pachyacris parviflora* show quite dramatic differences with the leaves having more spots of greater intensity than the stems and flowers.

Xysmalobium, *Gomphocarpus* and *Pachycarpus* have similar generic profiles, although once again *Pachycarpus* is slightly more complex with *P. schinzianus*, *P. plicatus* and *P. coronarius* showing some unique blue spots in the basal 1/3. *Pachyacris*, *Aidomene*, *Sigridia* and *Bruynsia* all have similar generic profiles. The significance of this is obscure, especially as these genera are not all closely related. *Periglossum* has a profile similar to, but more simple than, *Stenostelma*, to which it is morphologically allied. The South American *Araujia* has a profile similar to the *Pachyacris* group profile. Although the greenish brown spot, which can be found in the upper 1/3, and brown spot, which can be found in the lower 1/3, are unique. *Schizoglossum* has a generic profile that is unequaled elsewhere, including a set of unique pink coloured spots in the upper 1/3 of the plate. *Schizoglossum linifolium* [58] which must be removed from *Schizoglossum* (Kupicha, 1984) is similar to that genus in some respects but has no pink spot (as already mentioned) and also lacks a blue-purple spot just below the universal purple line just below halfway. This species also has a unique purple coloured spot near the bottom. *Woodia* [51] is somewhat like *Schizoglossum* in the lower half, but unlike this genus is featureless in the upper half. *Asclepias curassavica* from Central America seems similar to *Schizoglossum* and *Pentarrhinum*, but this must be considered due to convergence as the two are of quite different ancestry; although it does have a unique very light blue spot in the lower 1/3. Once again *Anisotoma* and *Tylophora* are almost featureless, except for a yellowish spot at the bottom of the plate in the former. The profiles of *Raphionacme* are also similar to those of *Schizoglossum* in the lower half, although the spots involved are of slightly different colour. The upper half is more or less featureless (figs. 4 & 5)

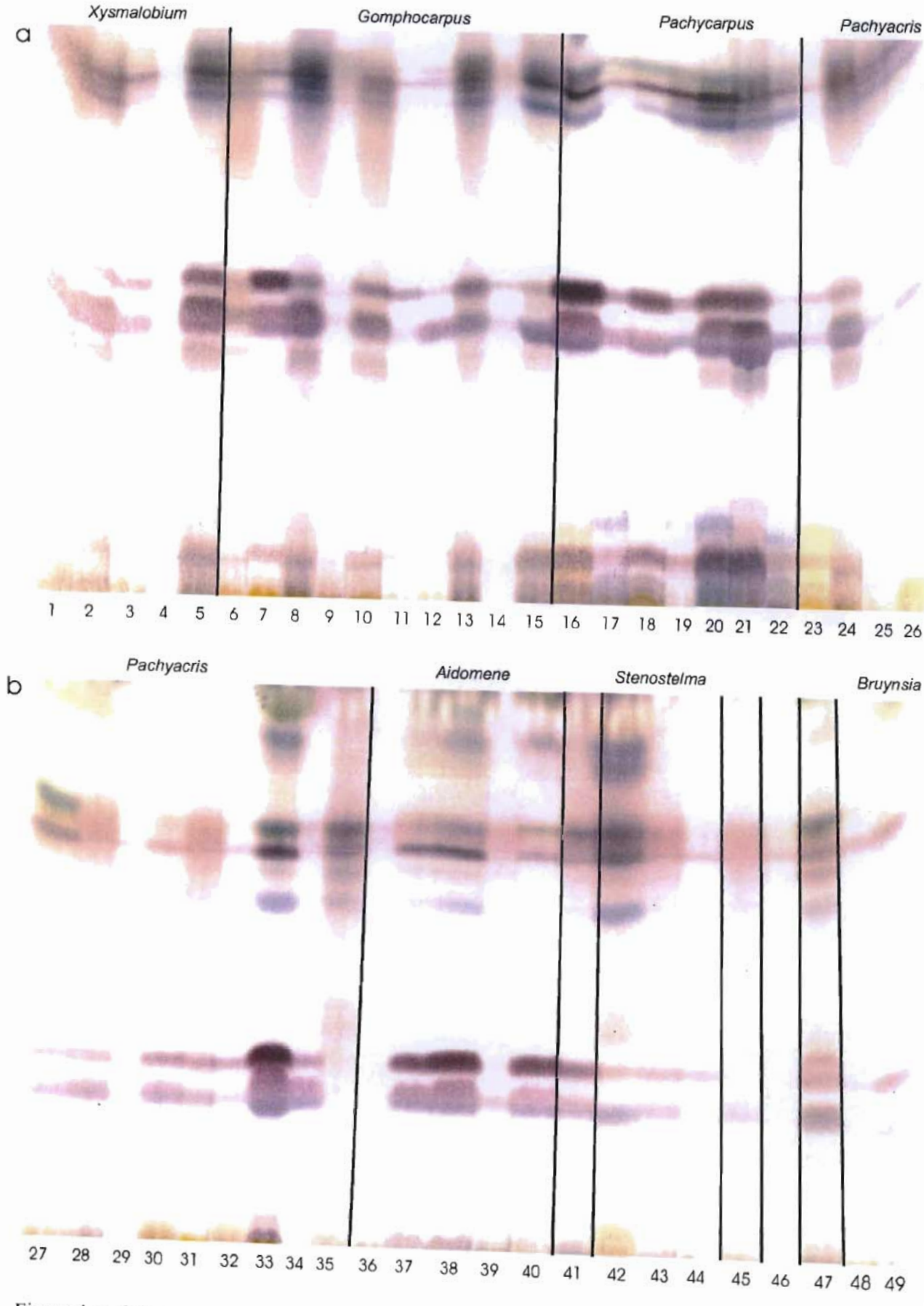


Figure 4. a. & b. 50/50 solvent system results.

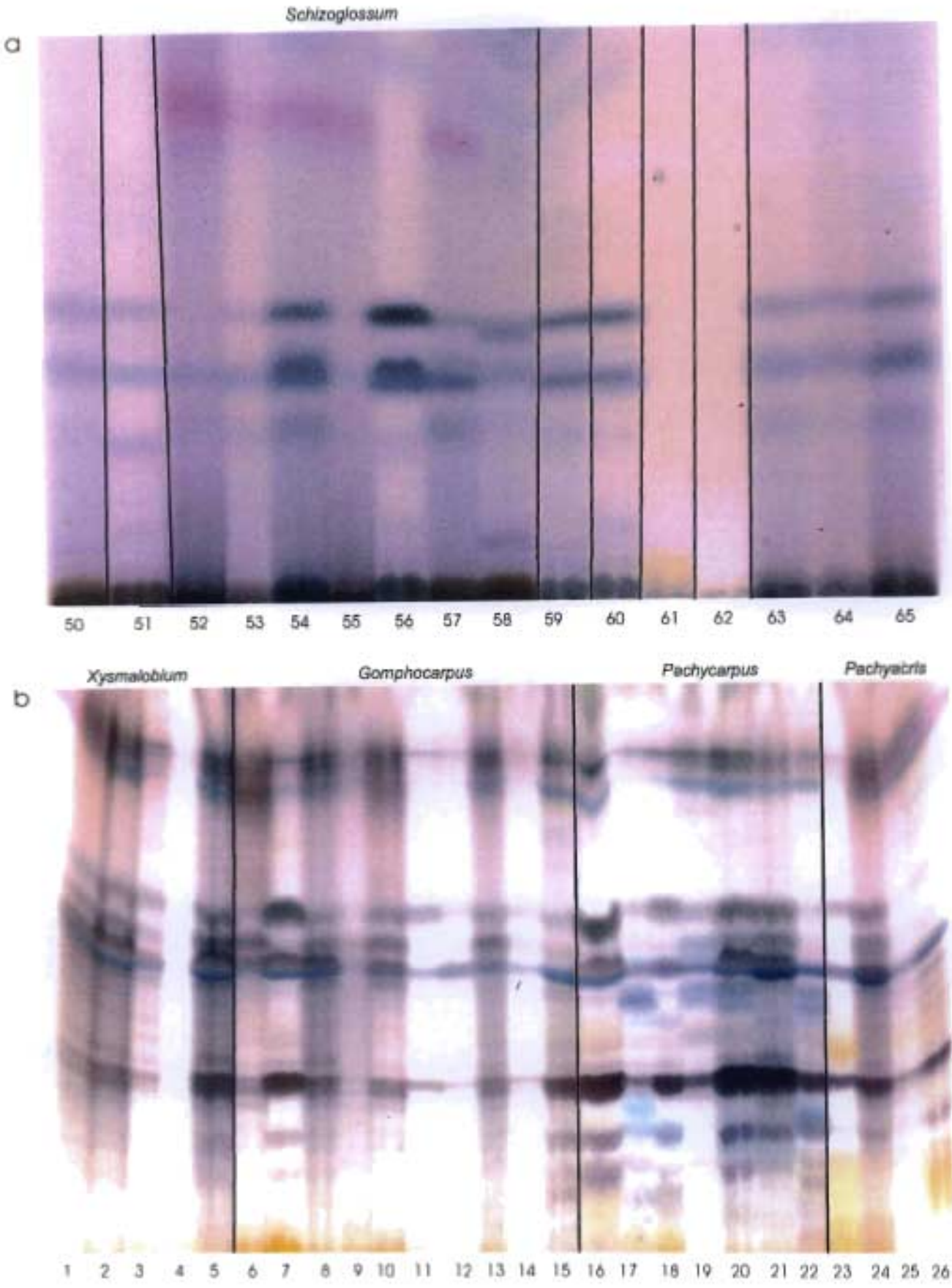


Figure 5. a. 50/50 solvent system result. b. Acid solvent system result.

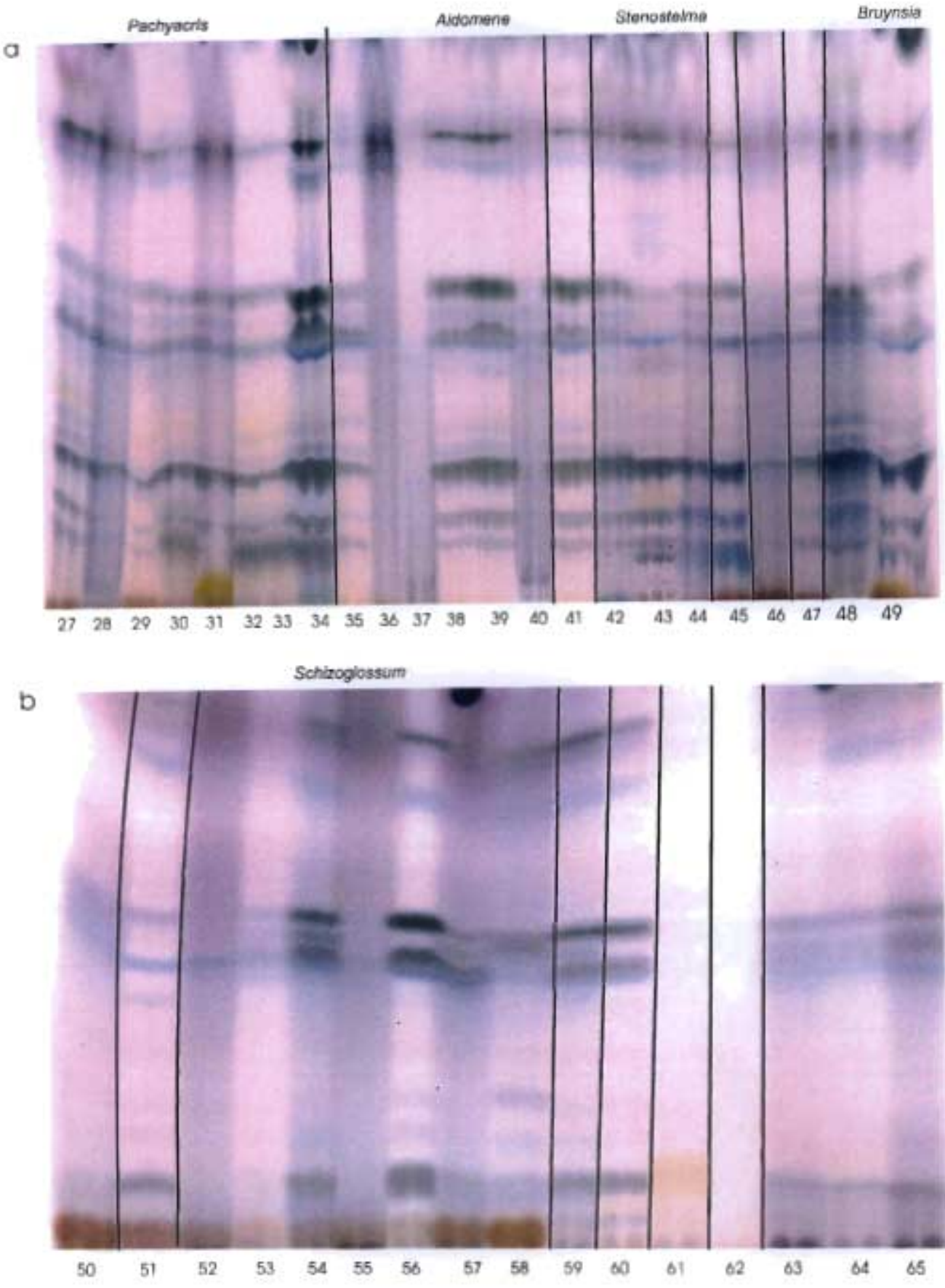


Figure 6. a. & b. Acid solvent system results.

Acid Solvent System

This solvent system separates the most polar of the chemicals in the secondary metabolite extract. Generally these chemicals are more polar because they are more complex and, therefore, are usually the result of more complex synthetic pathways. More complex pathways involve the evolution of new enzyme steps. As a result, these characters are more recent and more derived, that is apomorphic. One would expect more autapomorphic or unique chemicals here and this is certainly reflected in the results (figs 5 & 6). Universal bands, although, present are less dominant than in previous solvent systems. The patterns here reflect more recent relationships and evolutionary events. These plates show an increased number of brown and yellow spots. Dull browns are often ketones.

Within-plant variation in *Gomphocarpus fruticosus* [11 & 12], once again, shows little difference. However, in *Pachyacris parviflora* the reverse is true and the intensity and complexity of spots changes from the leaves to the flowers. In fact, the flower extract has a unique blue spot at both the bottom and near the top of their profile. This would mean that the most polar compounds are produced in the flowers; and not the stems and leaves. Why this should be so we are uncertain. We have not seen this phenomenon reported elsewhere in the literature, in fact, we have not seen any study done on the profiles of secondary metabolites in flowers. Most studies have concentrated on the stem-tubers (if these are produced) and leaves.

Within species or population variation remains the same in all species, as discussed under the 50/50 solvent system. Of interest, though, is the number of unique yellow coloured spots in *Pachyacris albens* collected at Vernon Crooks in KwaZulu-Natal [23]. These are not seen in the other populations of *P. albens* [24 to 26], although sample 26 does have one yellow spot. *Schizoglossum bidens* subsp. *pachyglossum* samples [52 to 56] are once again almost the same in there secondary metabolite profiles. *Stenostelma involucratum*, like *P. albens*, shows great variation. Sample 42 from the Eastern Cape has a unique basal blue-purple spot at the base. Sample 44 from KwaZulu-Natal is almost the same as 42, but without that basal blue-purple spot. Sample 43, also from KwaZulu-Natal is, however, quite different having a unique blue-purple spot at

about ¼ from the profile base and a yellow spot just above that, another unique purple spot occurs about halfway, while a purplish spot just above half-way is absent.

Xysmalobium, *Gomphocarpus*, *Pachycarpus*, *Pachyacris*, *Aidomene*, *Sigridia*, *Stenostelma*, *Periglossum* and *Bruynsia* have very similar generic profiles. *Xysmalobium* and *Gomphocarpus* have the simplest profiles, along with *Asclepias* [59] and *Pentarrhinum*. *Xysmalobium stockenstromense* Scott-Elliot and *X. undulatum* have very similar profiles. *Gomphocarpus fruticosus* and *G. physocarpus* once again have almost exactly the same profiles. These are very similar to those of *Xysmalobium*, except for two unique blue spots which occur in the lower ⅓. As in the 80/30 and 50/50 solvent systems *Pachycarpus* once again exhibits the most complex of all generic profiles, with quite a number of unique spots. In the lower ½ of the profiles there are a number of blue, purple and purple-brown spots that are not found in other genera, although some of these do appear in *Pachyacris*, *Aidomene*, *Sigridia*, *Stenostelma* and *Bruynsia*. Most interesting are the yellow spots that appear in *P. dealbatus* E. Mey. [16] and *P. schinzianus* [17]; both are considered basal in this genus (Nicholas & Baijnath, in press). These yellow spots are only found elsewhere in *P. albens* [23 & 26], *P. woodii* [31], *Stenostelma involucratum* [43], *Bruynsia disparilis* (N.E. Br.) Nicholas [49] and *Anisotoma cordifolium* Fenzl [61]. The profiles suggest that *Pachycarpus* and *Pachyacris* are similar vegetatively and may be related, although florally they are quite different. *Stenostelma* and *Bruynsia* are morphologically related, but not to *Pachycarpus* or *Pachyacris*. *Anisotoma* belongs in the tribe Stapelieae and not Asclepiadeae. In general the pattern of *Pachyacris* is somewhere between *Gomphocarpus* and *Pachycarpus* in complexity and profiles fairly uniform from species to species. This supports the congruence of this newly described genus which exhibits a wide range of morphological variation (Nicholas *et al.*, in press). *Aidomene* is similar to *Pachyacris* and *Gomphocarpus*, but certainly not as complex as *Pachycarpus*. *A. revoluta* and *A. cucullata* (which belong to the same subgenus *Astrocalymma*) are somewhat similar, however, *A. humilis* (which belongs to subgenus *Callocymbion*) has two unique purple spots near the plate base. The pattern in *Sigridia* is most similar to that of *Aidomene*. The two genera are, however, morphologically quite different. The pattern in *Stenostelma* is more like that of *Pachyacris* in its complexity, however, morphologically they are also quite distinct and

probably of different ancestry. The pattern of *Periglossum* [45] is almost the same as that of *Stenostelma* and *Bruynsia*. This fits well with the morphological data that places these genera near each other (Nicholas & Baijnath, in press). *Bruynsia gibba* (E. Mey.) Nicholas [46 & 50] and *B. eminens* (Harv.) Nicholas [48] have a similar profile; both belong to the subgenus *Bruynsia*. *B. disparilis* (N.E. Br.) Nicholas [49] has a unique yellow orange spot near the profile base and a blue one at about halfway; this species belongs to the subgenus *Cryptoglossa*. *Woodia* [51] is strangely free of spots, what there is resembles *Schizoglossum*. However, the two genera are not related. *Schizoglossum bidens* subsp. *pachyglossum* is fairly uniform and resembles *S. flavum*, still, this species differs in having a slightly different profile and a unique pinkish spot near the plate top. *S. linifolium* is quite different to the rest of *Schizoglossum*, having an unmatched mauve spot about a ¼ up the plate and a purplish one at halfway. This is further evidence that it should be removed from *Schizoglossum*. The *Pentarrhinum* profile [60] strangely resembles that of the New World *Asclepias* [59], nevertheless, they are not related. *Anisotoma* [61] apart from a yellow spot near the base is almost featureless, like *Tylophora* [62]. These plants probably do not abound with secondary metabolites. *Araujia* [47] from South America has a profile similar to but simpler than those of *Stenostelma*, *Aidomene* and *Pachyacris*. It is the large number of spots that are absent that make this profile unique. *Raphionacme*, from the subfamily Periplocoideae, is similar to that of *Schizoglossum*, but very much simpler. The significance of this is not apparent (fig. 5 & 6)

CONCLUSION

Chemical data, as an aid to classification and for tracing phylogenies, has proved itself important, but also sometimes fallible. The chemistry of the plant genome has taken over as the main focus of chemotaxonomy. However, micromolecules still have a part to play. Unlike asclepiads of Asia, those of Africa have been little investigated and then generally only if of suspect medicinal importance. The study of the secondary metabolite profiles done here is without parallel for the family Apocynaceae in southern Africa. **Within-plant variation:** The profiles of the leaves and flowers of *G. fruticosus* are almost

exactly the same. In contrast, *P. parviflora* has profiles that show the flowers of this species have many more polar chemicals in the flowers, while the leaves and stems have fewer such chemicals but abound in less polar compounds.

Infraspecific variation: Some taxa, such as *Schizoglossum bidens* subsp. *pachyglossum* have populations that are widely separated both spatially and temporally, but which exhibit fairly uniform profiles. Others, like *P. albens*, have populations with fairly diverse profiles.

Generic variation and phylogeny: While a some genera, such as *Gomphocarpus*, have species (*G. fruticosus* and *G. physocarpus*) which exhibit profiles that can't be told apart, others ,such as *Pachycarpus*, have species profiles quite diverse. In general, the results obtained are of mixed value, sometimes supporting generic patterns seen in the morphological data and sometimes at conflict with them. At times, the importance of the patterns for both classification and phylogeny are obscure. However, there is a clear increase in the complexity of profiles as one moves from the clearly plesiomorphic profiles of *Xysmalobium* to *Pachyacris* and *Aidomene*. This finding agrees with the morphological data that suggests *Xysmalobium* is almost basal in the subtribe Asclepiadinae, and genera such as *Aidomene* more advanced. It would be interesting to compare the profiles of *Xysmalobium* with that of the tropical genus *Calotropis*; which is probably the most primitive living member of the subtribe in Africa. The simplicity in the profiles of *Gomphocarpus* is a surprise, considering the success of this genus. It would be interesting to compare them with that of *Kanahia*, a genus from which they probably evolved. *Kanahia* is, in turn, close to the basal genera of the subtribe. The surprise at the simplicity of *Gomphocarpus* is equalled by the complexity of the profiles in *Pachycarpus*, a complexity unparalleled by other genera in this study. The similarity of the profiles of *Pachycarpus* and *Pachyacris* may suggest a common ancestry for these groups. This is interesting as no clues as to the affinity of *Pachyacris* have been forth coming from morphological data. The simplicity of the profiles of *Woodia* and *Schizoglossum* is unexpected, especially as the morphological evidence suggests that they are very derived genera. The profiles also give no clues about the possible ancestry of both these important genera. *Woodia*, morphologically, is, without doubt, linked to *Xysmalobium* and basal species of *Pachycarpus* (such as *P. dealbatus)*, but this is not

reflected in the chemistry. Both morphology and chemistry gives no clue as to the origins of *Schizoglossum*. Unfortunately, as we only sampled three *Schizoglossum* species, we have been unable to support our contention that this genus is paraphyletic. However, the profiles definitely suggest that *S. linifolium* should be removed from *Schizoglossum*, as suggested by Kupicha (1984). The lack of complexity in the profiles obtained for *Schizoglossum*, *Woodia*, *Pentarrhinum*, *Asclepias* and *Raphionacme*, run in the acid solvent system, are interesting as these genera are not related. The New World genera, *Araujia sericofera* and *Asclepias curassavica*, have profiles that are exceedingly similar to African species, although they are also marginally unique; being slightly different from not only the African species, but also each other. We had, however, hoped for dramatically different profiles for these two non African species.

Infrafamilial variation: The profiles of *Raphionacme* (Periplocoideae), *Anisotoma* (Asclepiadoideae: Stapelieae) and *Pentarrhinum* (Asclepiadoideae: Asclepiadeae: Cynanchinae) are not sufficiently different from the other profiles (all Asclepiadoideae: Asclepiadeae: Asclepiadinae) for us to draw any conclusions on the infrafamilial classification of the Apocynaceae; although these latter genera are definitely more similar to each other than they are to *Pentarrhinum*, *Anisotoma* and *Raphionacme*.

Although, this is, to date, the largest study of its kind. for the Asclepiadinae in southern Africa the sample base is still small. Only18% of the species and 56% of the genera having been investigated here. This sample size needs to be increased, and within-plant and infraspecific variation studied further.

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CHAPTER 6

THE ASCLEPIADACEOUS WORKS OF RUDOLF SCHLECHTER

"It is a great pity that Dr Schlechter ..... did not live long enough to write an account of his own life and travels. Such would have been a story of hardship and endeavour scarcely equalled by anyone in the history of botanical exploration." — Hutchinson, 1946*

Introduction: Any taxonomist who has worked on the flora of southern Africa would have come across either specimens collected by Schlechter or literature written by him. For workers in the Orchidaceae and Asclepiadaceae this is particularly true. Almost half of all the species described for the southern African Asclepiadinae were named by him, the majority of these based on type specimens he himself collected. Unfortunately, due to the bombing of the Berlin Herbarium, during the Second World War, Schlechter's holotype collections of Asclepiadaceae were destroyed. Despite the fact that he collected as many as 100 duplicates on occasion, some numbers are nevertheless scarce and workers often encounter problems in tracing these. For unicates we have lost the only record available and, as a result, the proper application of the associated names to more modern collections are often uncertain or problematic. The research for this paper was initially done in order help alleviate this problem by trace all the literature associated with these names and types.

CONTENTS

* HUTCHINSON, J. 1946. **A botanist in Southern Africa.** London.

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A. NICHOLAS

The Asclepiadaceous works of Rudolf F. Schlechter (1872–1925)

Abstract

Nicholas, A.: The Asclepiadaceous works of Rudolf F. Schlechter (1872–1925). - Willdenowia 22: 215-264. 1992. - ISSN 0511-9816.

Rudolf Schlechter's prodigious contribution to the study of the family *Asclepiadaceae* (including *Periplocaceae*) is examined. A list of his Asclepiadaceous works is given, and linked to a set of three indices which deal with geography, taxonomy and plant collections respectively.

Introduction

Friedrich Richard Rudolf Schlechter was born on 16th October 1872 in Berlin. He was the third child in a family of six and son of Hugo Schlechter, a lithographer. After completing his schooling at the Royal Friedrich-Wilhelms-Gymnasium, Rudolf began his working career as an assistant gardener in the Berlin University Garden. He did not stay there long, however, for, at the age of 19, he set sail for South Africa (Loesener 1926).

Schlechter arrived at Cape Town in November 1891, where he worked as a *Phylloxera* inspector (Hoehne, Kuhlmann & Handro 1941) and as a gardener, before being employed by Dr Harry Bolus in his private herbarium. This herbarium, in which Rudolf was an assistant technician and librarian, later became the well known Bolus herbarium of the Department of Botany at Cape Town University. Like many South African herbaria it contains duplicates, including types, of much of Schlechter's southern African collections. December 1891 to October 1892 Schlechter seems to have collected in areas easily accessible from his Cape Town base; however, after presumably taking leave of Bolus in this month he set out to explore more of South Africa. After botanizing in the southern and eastern Cape, Transkei, Natal and Transvaal (Schinz 1892, Morot 1895, Phillips 1930) he returned to Cape Town in March 1895 (Gunn & Codd 1981).

It was during this period that Schlechter published his first paper on the two families, the *Orchidaceae* and *Asclepiadaceae*, in which he would later specialize and to which he would devote much of his life. During the 32 years that followed the publication of this paper, Schlechter produced some 67 publications on the *Asclepiadaceae*, 18 of these in the journal Botanische Jahrbücher. In these works, he dealt with 151 genera (of which he personally described 38) and ± 1331 species (of which he named about 687). His work also covered much of the tropical and subtropical parts of the world and dealt with the asclepiad floras of countries as far apart as Ecuador, Togo and Papua New Guinea. Ironically Schlechter's last paper on the *Asclepiadaceae* was published in 1926, some time after his death. Despite the fact that many of his names are now in synonymy, his contribution to our knowledge of the *Asclepiadaceae* was enormous and

Fig. 1. Friedrich Richard Rudolf Schlechter (1872–1925) – Photograph (National Botanical Institute, Pretoria).

along with N. E. Brown, A. A. Bullock, K. Schumann and R. E. Woodson was one of the five main forces that shaped the structure of *Asclepiadaceae* taxonomy as we see and understand it today. However, these monumental events were still to come in the young Schlechter's life.

Schlechter returned with his substantial collections to Europe where, for a while, he worked on them at the British Museum of Natural History in London. It was here that he met A. B. Rendle with whom he later produced some joint research on the *Asclepiadaceae* of tropical Africa. In January 1896 Schlechter returned to South Africa for a second collecting expedition, part of which was done in the company of his younger brother Max (Anon. 1896). This time he explored mainly the west and north western Cape – proceeding from Cape Town towards Namaqualand and the Orange River (Anon. 1897, Wilms 1897). He returned to Cape Town in November 1897 and set sail for Mozambique, where he collected specimens for almost four months. During this time he undertook excursions into the eastern Transvaal (Codd & Gunn 1979) and to Mutari in Zimbabwe (Jessop 1964). Apparently weakened from fever and dysentery, he returned to Germany in April 1898 where he began university studies in Berlin.

At university Schlechter was to come into contact with a number of important German botanists, i.e. A. Engler, L. Diels and O. Warburg. Of these Otto Warburg, a well respected economic botanist, was to influence his life most. It was probably through Warburg's efforts that Schlechter was sent on the Kautschuk-Expedition to West Africa in 1899–1900 (Letouzey 1968). Economic plant resources, particularly rubber or rubber substitutes, were an important consideration at this time and it was thus no surprise that the Kolonial-Wirtschaftliches-Komitee, pleased with his performance, made use of this services again shortly after his return from West Africa. This time he was sent to Malaysia, Indonesia and the South Sea islands – a journey that was to begin an intimate and life long relationship with this botanically rich and interesting region of the world. It was also to introduce Schlechter to an *Asclepiadaceae* flora quite differ-

ent from the one with which he had become acquainted in Africa. His personal collections would, from now on, become filled with, amongst other things, many new and exotic species of *Hoya* and *Dischidia*.

Schlechter arrived at the Malay Peninsula in early January 1901 and chose Singapore Botanic Gardens as a base for his first excursions into the region. From here he moved on to German New Guinea (now Papua New Guinea) where he explored the mainland and surrounding islands (Lauterbauch 1905). In 1902 he proceeded to Sydney and then on to New Caledonia for a collecting trip, finally returning to Germany in 1903 by sailing via Australia and Sri Lanka.

In 1904 Schlechter completed his doctoral thesis which dealt with the phytogeography of New Caledonia. Soon after, in June 1905, he found himself back in West Africa mainly to assess progress with the cultivation and tapping of *Kibatalia* (syn. *Kickxia*). He did not stay long, however, as he returned to Europe some seven months later.

In October 1906 Schlechter set out on his second journey to the islands of Australasia and the Far East. This was to be the last and longest of his collecting trips. In the three and a half years he was away he would visit and collect in Malaysia, Sarawak, Java, Hongkong, Philippines, Sumatra, Borneo and Papua New Guinea. It was in this last country that he set up base for just on three years and, during this time, he explored both the mainland and surrounding islands of the Bismarck Archipelago quite extensively. Although, it is his botanical exploration during this period that we remember most this was, in fact, secondary to his main work which involved the gutta-percha and rubber industry (van Steenis-Kruseman, 1950) for, amongst other things, Schlechter's sponsors, the Kolonial-Wirtschaftliches Komitee, had requested that he establish a rubber research station at Bulu in German New Guinea (Frodin 1975).

In October 1909 Schlechter left Papua New Guinea, travelling home via Sulawesi (Celebes), Sumatra, Sri Lanka, Suqutra (Socotra) and Aden, arriving in Germany in May 1910. He was to remain in Europe for the rest of his life, presumably concentrating his energies on his family (in August 1910 he married Alexandra Sobennikoff shortly after his return from Malaysia and had two daughters by her) and career (he was appointed assistant [1913] and then curator [1921] of the Berlin Botanical Museum). Here he worked until his death five years later on 16th November, 1925, a month after his 53rd birthday (Anon. 1926, Loesener 1926). The fact that Schlechter managed to accomplish so much in the short 32 years he was a practicing botanist, makes his enormous contribution to orchid (Ames 1933) and asclepiad taxonomy all the more astounding and bears credence to Rendle's comments (1926) that he was an "indefatigable worker". In his later years Schlechter tended to concentrate mainly on the family *Orchidaceae*, although a number of important *Asclepiadaceae* papers were also published during this period. In particular, works dealing with the asclepiads of, among other places, Indonesia/Philippines, Bolivia and China, appeared between 1915 and 1925. However, it must not be thought that Schlechter worked only on *Asclepiadaceae* and *Orchidaceae*. A look at the Schlechterian bibliography given by Loesener (1926) reveals that his researches extended to families as diverse as the *Magnoliaceae*, *Gesneriaceae*, *Zygophyllaceae*, *Bruniaceae* and many others. Apparently, he was also a frequent visitor to Kew and the British Museum (Hall 1978).

It was unfortunate that, during the First World War, Schlechter had to witness the collapse of the New Guinea rubber industry, an enterprise he had spent so much time and energy building. Fortunately, he was not alive to see the second major blow to his life work, when much of his botanical collection was destroyed along with the Berlin Herbarium in the Second World War (Ames 1944). 125 *Asclepiadaceae* specimens, including some Schlechter types, were out on loan at the time the Berlin herbarium was destroyed (Hiepko 1978) and, regrettably, these seem to be all that remain of his once extensive, irreplaceable holotype collections in this family. Fortuitously, Schlechter did collect duplicates (apparently as many as 100 on occasion – see Gunn & Codd 1981) which he distributed to herbaria in Europe and overseas (Leeuwenberg 1965). Eventually some of these isotypes and isosyntypes will become the lectotypes of his many *Asclepiadaceae* names.

Despite the destruction of much of his life's work, Schlechter's remaining contribution continues to influence all those who work within the *Orchidaceae* and *Asclepiadaceae* and with the general floras of

Southern Africa and Australasia as well. One indication of the degree to which he influenced world botany is the extent of Schlechterian eponymy. At the generic level, he has had 8 taxa named after him, i.e. *Rudolfiella* Hoehne, *Schlechteranthus* Schwantes, x*Schlechterara* L. A. Gray & Sweet, *Schlechterella* Schumann, *Schlechteria* Bolus, *Schlechterianthus* Quis., *Schlechteriana* Harms, *Schlechterosciadium* H. Wolff.

Of these only *Schlechterella* and *Schlechterianthus* belong to the *Asclepiadaceae*.

At the specific level, few botanists can have been honoured as often as Schlechter in terms of the number of epithets dedicated to him. Of the approximately 386 noted by this author, 11 are in the *Asclepiadaceae*, i.e. *Astephanus schlechterianus* Urban, *Ceropegia schlechteriana* Werderm., *Cynanchum schlechterianum* Warb., *Ditassa schlechteri* Macbride, *Gomphocarpus schlechteri* Schumann, *Gymnema schlechterianum* Warb., *Hoya schlechteriana* S. Moore, *Marsdenia schlechteriana* Rothe, *Metastelma schlechteri* Macbride, *Oxypetalum schlechteri* Malme, *Schizoglossum schlechteri* N. E. Br.

Plants bearing his name are not restricted to the *Asclepiadaceae* and *Orchidaceae* but come from families as far apart, and unusual, as the *Arecaceae (Calamus schlechterianus* Beccari), *Solanaceae (Solanum schlechterianum* Bitter) and *Podostemaceae (Dicraea schlechteri* Engl.). As far as could be ascertained, the break down of Schlechterian eponymy at the species level is as follows: Names ending *schlechteri* (including those published as *schlechterii* and correct here in accordance with ICBN rules) = ± 338. Names ending *schlechteriana* = ± 27. Names ending *schlechterianum* = ± 13. Names ending *schlechterianus* = ± 5. Names ending *rudolphii* = ± 3.

In addition to the above commemorations, New Guinea apparently produced a set of stamps in 1970 honouring Schlechter (Stafleu & Cowan 1985) and more recently, c. 1990, a German journal dedicated to the study of orchids has been named Schlechteriana after him. In summing up the life of Rudolf Schlechter, one can probably do no better than the tribute paid to him by Hutchinson (1946) when he said: "It is a great pity that Dr Schlechter... did not live long enough to write an account of his own life and travels. Such would have been a story of hardship and endeavour scarcely equalled by anyone in the history of botanical exploration."

The following references are suggested as the best sources of information of a biographical nature: Loesener 1926, Hoehne, Kuhlmann & Handro 1941, Frodin 1975, Gunn & Codd 1981 and Kloppenburg 1992. For details of Schlechter's collecting itineraries and collection numbers try: Loesener 1926, van Steenis-Kruseman 1950, Jessop 1964, Gunn & Codd 1981 and Blaxell 1982. Bibliographical information can be obtained from: Loesener 1926, Merrill 1926, 1937, 1947, Bullock 1978 and Stafleu & Cowan 1985. All of Schlechter's *Asclepiadaceae* literature listed by Loesener (1926) may be found in the library of the Botanischer Garten und Botanisches Museum Berlin-Dahlem (Lack, H. W., pers. comm.).

Although some inventories and publication lists have been made of Schlechter's orchid work (Lückel 1981, Pabst & Dungs 1977 and Cribb, Lee & Wood 1981), nothing similar seems to have been done regarding his Asclepiadaceous endeavours. Hopefully this paper will fill this vacuum and give his asclepiad work the attention it deserves.

Following this introduction 67 *Asclepiadaceae* papers, written by Schlechter, have been listed; please communicate any errors or omissions to the author. The list is roughly divided into three sections:

Literature numbered 1 to 18 are all those papers published in Botanische Jahrbücher. Literature numbered 19 to 54 are those papers produced in German, Austrian and Swiss publications other than Botanische Jahrbücher. Literature 55 to 67 are all those papers published in English speaking journals. Within each of these three sections, references are cited in chronological order except when they form part of a continuing series, in which case these are placed consecutively.

Following the list there are a set of three indices which refer back to this literature list. The numbers in the index refer to the appropriately numbered reference in the literature list.

The first index is to all those countries in the world with whose *Asclepiadaceous* flora Schlechter worked. Larger countries such as China have been broken down into appropriate provinces or states.

The second index is the largest and is a list of all the *Asclepiadaceae* genera and species dealt with by

Schlechter. If the taxon concerned was described by him then the literature reference number relating to the protologue or original description is given in bold face. Types specimens, if cited, are given in brackets after the species name. Author names when abbreviated follow Meikle (1980). Some new combinations made by Schlechter, but missed by the compilers of Index Kewensis, are also given. Numerous Schlechter manuscript names, mostly written on herbarium sheets scattered world wide, are not given in this taxonomic index; however, workers in the *Asclepiadaceae* should be aware of these invalid names as they are often a sources of confusion. In fact, recently some authors (Burton 1987, Kloppenburg 1990) have published some of Schlechter's manuscript names in the genus *Hoya* – in this case a possibly unwise practise that has caused much debate (Forster 1991). For completeness these names (now valid under the Botanical Code of Nomenclature) have been included in the taxonomic index. Workers should also be aware that many Philippine collections (e.g. *Ramos*) are not personal numbers but Bureau of Science numbers (Forster, P. I., pers. comm.).

The last index is of those workers who collaborated with Schlechter or whose plant collections he consulted during the course of his *Asclepiaduceae* studies.

A list of the Asclepiadaceous works of Rudolf Schlechter

1. Schlechter, R. 1894: Beiträge zur Kenntnis südafrikanischer Asclepiadaceen. – Bot. Jahrb. Syst. 18 Beibl. 45: 1–37.
2. — 1895: Beiträge zur Kenntnis südafrikanischer Asclepiadaceen. – Bot. Jahrb. Syst. 20 Beibl. 51.
3. — 1896: Die Drège'schen Asclepiadaceen im Ernst Meyer'schen Herbar. – Bot. Jahrb. Syst. 21 Beibl. 54: 1–14.
4. — 1900: Eine neue Gattung der *Asclepiadaceae*. – Bot. Jahrb. Syst. 29 Beibl. 66: 21–22.
5. — & Schumann, K. 1903: *Gomphocarpus buchwaldii*, *Stathmostema macropetalum*, *Tylophora plagiopetala* & *Pergularia adenophylla*, p. 324–326, 330–331. – In: Schumann, K., *Asclepiadaceae* africanae, p. 322–331. – In: Engler, A. (ed.), Beiträge zur Flora von Afrika XXIV. – Bot. Jahrb. Syst. 33: 1–386.
6. — 1904: *Asclepiadaceae* , p. 15–16. – In: Sodiro, A., S.J., Plantae ecuadorenses. III. – Bot. Jahrb. Syst. 34: Beibl. 78.
7. — 1905: *Asclepiadaceae*, p. 91–92. – In: Diels, L., Beiträge zur Flora des Tsin ling shan und andere Zusätze zur Flora von Central-China. – Bot. Jahrb. Syst. 36 Beibl. 82: 1–138.
8. — 1905: *Asclepiadaceae* africanae, p. 28–56. – In: Engler, A. (ed.), Beiträge zur Flora von Afrika XXVIII. – Bot. Jahrb. Syst. 38: 1–129.
9. — 1913: *Asclepiadaceae* africanae, p. 129–155. – Engler, A. (ed.), Beiträge zur Flora von Afrika XLII. – Bot. Jahrb. Syst. 51: 1–163.
10. — 1906: *Asclepiadaceae* andinae, p. 601–627. – In: Urban, I. (ed.), Plantae novae andinae imprimis Weberbauerianae. II. – Bot. Jahrb. Syst. 37: 503–646.
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Index 3: Collaborators & collections examined

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Address of the author:
A. Nicholas, National Botanical Institute, Private Bag X101, Pretoria 0001, South Africa.

CHAPTER 7

CONCLUSION

It seems appropriate to end with some pertinent scientific points made by the late philosopher, Karl Popper, and then relate these to the findings presented in this dissertation.

The first of these is the popular, but false, notion (even amongst scientists) that science is a body of established facts. Nothing in science is permanently established and nothing unalterable (Magee, 1973). Science is clearly dynamic and changing all the time. This change is, however, not brought about through the accretion of new certainties, but via a series of approximations towards the truth. Some believe we will never reach the "truth," others believe it to be possible; the debate is still ongoing. However, if we do not know exactly what the truth is, how will we know when we have reached it?

If this is so, then, like all sciences, taxonomy is on a journey towards the truth; viz. towards that one single unchanging certainty. As taxonomists, our work will never be final. It is flawed to think that any classification, even one's own, will not eventually be superseded. Just as Newton's theory on gravitation was replaced by that of Einstein's, so too was Decaisne's classification of the Asclepiadinae superseded by that of Schumann's. This does not mean that Newton's laws or Decaisne's classification no longer works, they are just not a fuller story and are, thus, no longer as relevant in the present scientific paradigm as they once were. Each successive classification is a more precise interpretation of the pattern discernible amongst the taxa being studied.

The findings presented here, hopefully, represent just such a further step in the refinement of our knowledge regarding the patterns of affinity exhibited by the taxa of the Asclepiadinae. However, I cannot claim it to be the truth, but it is as close as I have been able to come, given the data and techniques available to me. It is in the spirit of scientific enterprise that I present my findings here to the botanical community to be experimentally challenged or, in Popperian terms, falsified, not only by others, but also by myself as my work continues.

The presentation of this classification does not mean that the work on this subtribe, that has gone before, is any less significant to our pursuit for the truth. As mentioned in the introduction, science is a co-operative endeavour and evolves by the accumulation of knowledge contributed by many workers, past and present (Rangachari, 1994). Science does not happen due to one big epiphany, but is a process of many small discoveries that are only possible because of the many other small discoveries that have gone before. Some discoveries are just bigger than others, but each plays its part. Humanity is collectively attempting to creep its way towards the "truth."

Taxonomy is, unfortunately, always deriding itself because it is seen by the majority of the scientific community, especially other fields of botany, as not being empirical and, therefore, not really science. This, of course, is not true. Both Popper and, the humanist psychologist, Carl Rogers, have pointed out that science is deluding itself if it thinks it is completely empirical and that it can elucidate unchanging certainties about the universe through experimentation. However, the process of experimentation and falsification are all that we have at our disposal and they work well enough providing we remain aware at all times of the human element involved in these processes.

Unlike some other disciplines, taxonomists have, at least, to some extent, been honest about the human factor involved in our science. We should take pride in this, rather than the continual self-flagellation evident in the scientific press and at conferences. It is also a pity that this strength is seen as a weakness and that it drives some taxonomists to see only mathematically generated classifications as important. They delude themselves that these machine driven techniques are free from human bias (the fallacy of *tabula rasa* [Takhtajan, 1988]) and are, thus, mentally blind to how inaccurate some of their classifications could be. The attitude is prevalent that if a machine produced it then it must be the truth. At least, orthodox taxonomy, for all its faults, is well aware of the human bias in its classifications and is, as a result, guarded from the start about the certainty of its own conclusions. However, this does not mean that taxonomists should not follow strict scientific protocol, they should do so even more carefully. I have tried my best to do so in this study. In particular, specimen citation has been extensive; although by no means have I listed all the specimens examined by myself. These cited specimens represent data points and it is largely their existence that makes taxonomic

research repeatable; one of the tenants of empirical science. The knowledge of, not just taxonomy, but botany itself, is built up of interrelated concepts that are ultimately connected to actual plant specimens (Cotterill, 1995).

Popper also maintained that every discovery opens new problems for us. He realised that our ignorance grew with our knowledge (Magee, 1973). I have certainly been aware of this during the past 17 years that I have been practising taxonomy. This doctoral study has been no exception. It is these desiderata, these continually growing gaps in my understanding, that have driven my research and kept me fascinated with the plants that I have come to both admire and love.

In light of the above discussion, although the classification outlined in this thesis is far from the last word on the classification of the subtribe Asclepiadinae in southern Africa, I sincerely hope that it contributes substantially to our understanding of the group. I also hope that it will prove to be a useful tool for both taxonomists and conservationists. The size of this work might seem to indicate that it is a comprehensive study; I have tried my best to make it so. However, there are still many problems that need to be solved, not least of which is a clearer understanding of the evolution and structure of *Schizoglossum* and its allies. Cladistic and DNA studies for the entire subtribe Asclepiadinae are also urgently required.

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APPENDICIES

Published Papers

Unpublished Papers

Why has generic delimitation in parts of the family Asclepiadaceae been a contentious, and perennial problem?

by Ashley Nicholas

S.A. Liaison Botanist, The Herbarium, Royal Botanic Gardens, Kew

Reprinted from an open letter published in the *I.O.S. Asclepiadaceae Working Group Newsletter*, December 1989, with the kind permission of the author and Prof. Dr. Focke Albers.

The formation of the Asclepiadaceae Working Group affords me the opportunity to throw open ideas, already discussed with Johan Venter (University of Bloemfontein), Doug Stevens (Missouri Botanical Gardens) and Glenn Adelson (Arnold Arboretum), to a wider audience.

Let me first support the statement I make in the title to this discussion, viz. that generic delimitation in parts of the family Asclepiadaceae has been a contentious, and perennial, problem! Schumann, Schlechter, Baillon, and N.E. Brown were all working in the tribe Asclepiadeae at about the same time. They all examined the same material, consulted the same literature, and yet came up with quite different generic concepts for some african taxa. For instance Schlechter sunk *Gomphocarpus*, *Pachycarpus* and *Xysmalobium* under *Asclepias*, but retained *Stathmostelma* as distinct. N.E. Brown on the other hand maintained *Pachycarpus* and *Xysmalobium* as distinct, but sank *Gomphocarpus* and *Stathmostelma* under *Asclepias*. Schumann retained all these as separate genera (with *Pachycarpus* as a section under *Gomphocarpus*), while Baillon did exactly the opposite, and united all of them under *Asclepias* (including *Schizoglossum* which the others had always maintained as distinct). Let's face it, you can't get much more confusion than that.

I had to ask myself "Why all this confusion?" Why did four different workers come to four different conclusions, based on the same information? The answer seems obvious, although their work is good and meticulous, they could not have properly understood the affinities of the taxa they were dealing with. If they had understood the intrinsic relationships existing between the groups involved, there would surely have been greater consensus at the generic level. Why was it then that these four workers failed to grasp the underlying phylogenetic pattern governing the diversity they saw in the material they examined?

These taxonomists are what I shall call the traditionalists. They practiced taxonomy at a time when evolutionary concepts, and the laws governing them, were not well understood. They tended, as was tradition at the time, to define their genera using as few (mainly floral) characteristics as possible. Thus N.E. Brown placed all the species possessing a corona-lobe sinus in the genus *Asclepias*, and all species with a blob-like corona-lobe in the genus *Xysmalobium*, and so on. If you don't think phylogenetically, homoplastic morphologies are something you just don't consider. As a result it probably did not occur to these taxonomists that quite unrelated taxa may have evolved the same type of structures independently. For instance, due to the same evolutionary and genetic pressures, there may have been a trend in one direction for the corona-lobes of unrelated taxa to become reduced to a globose blob (*Xysmalobium*), and in the other direction for the corona-lobes of these same unrelated taxa to become saccate (*Asclepias*), or ornamented (*Schizoglossum*). As a result quite unrelated taxa may end up in the same genus because they exhibited a similar end condition, or conversely a natural taxon may find itself with member species scattered in several different genera. If this is the case no wonder there is such generic confusion in the tribe – taxonomists were looking at the analogous end products of evolution and not at the trends that produced them.

Bullock was the first taxonomist, dealing with african asclepiads, to grow up in a world with a clear conception of evolution and the laws and forces governing it. He realised that some of the larger genera of the traditionalists were false in that, although well defined, they contained a number of unrelated groups. As a result he began to restructure and re-circumscribe many african asclepiad genera taking this into account. Bullock has not been the only worker to use a phylogenetic basis for taxonomic treatments in the family; recently other workers such as Francis Kupicha (*Schizoglossum et al.*) have also done so. For this discussion I will refer to these workers as the evolutionists.

The evolutionists, however, have a problem. By taking convergent evolution into account, they cannot use the clear single character generic separations of the traditionalists. So how, in this maze of homoplastic morphologies, are they going to establish the true phylogenetic nature of genera in the tribe? There is no doubt in my mind that there is only one way this can be done, and that is by using the patterns produced by **consistently exhibited correlated characters.** Only in this way will we arrive at a more phylogenetically based classification for the tribe Asclepiadeae in Africa. It is unfortunate that the use of such consistently produced linked characters, or character combinations, makes the construction of keys complicated, but then this is a small price to pay for taxonomic stability.

To summarise: The older classifications founded, as they were to a large extent, on single floral characters (mainly corona-lobe structure) offer us order. This traditional approach produces genera which are a mixture of unrelated species. However, these large taxa are convenient, and they are also conceptually easy to grasp and deal with. The modern approach (i.e. taking cognizance of the intrinsic, evolution produced, pattern of relationship existing between the taxa concerned) will result in genera that are congruous phylogenetic units, but which are unfortunately often small, less easily defined and take a little more brain power to comprehend and work with.

You may say that because some of the older systems work well, why not stick to them, even though they do not express phylogeny. I suspect there is something to be said for this approach if one is at all times aware that the classification being used gives no indication of the true relationship of the species involved, and is merely one of convenience. However, classifications are information carrying systems, and the classification that carries the largest amount of organised, easily accessible information, must surely be the better one, and the one more meaningful to the serious user. Such a classification can only be produced if it is phylogenetically based, therefore I have no choice but to cast my vote in favour of such a system.

PLATE 1991

RIOCREUXIA FLANAGANII

Southern Africa

ASCLEPIADACEAE

Riocreuxia flanaganii *Schltr.* in Bot. Jb. 18, Beibl. 45: 13 (1894); N.E. Br. in Fl. Cap. 4,1: 804 (1908); R.A. Dyer in Bothalia 12,4: 632 (1979); Fl. sth. Afr. 27,4: 87 (1980); *Ceropegia, Brachystelma & Riocreuxia* in southern Africa 235 (1983). *Ceropegia flanaganii* (Schltr.) Huber var. *flanaganii*, Huber in Mem. Soc. broteriana 12: 168–170 (1957).

This seldom-collected, but attractive species was named in honour of H. G. Flanagan. One of South Africa's earliest citrus farmers, Flanagan was a keen amateur botanist who collected intensively in the eastern Cape and adjacent areas.

Riocreuxia is a taxonomically difficult group (like many other asclepiadaceous genera) and this is, in part, due to a complicated evolutionary history. R. Schlechter, K. Schumann, N. E. Brown and R. A. Dyer have all commented on the complexity of the genus. It is, therefore, not surprising that *R. flanaganii* has had a taxonomically chequered history. Huber had placed it (along with the other *Riocreuxia* species) in the genus *Ceropegia*. At one stage *R. woodii* N.E. Br. was reduced to subspecific rank under *R. flanaganii* and two new subspecies were proposed, namely, *segregata* R. A. Dyer and *alexandrina* (Huber) R. A. Dyer. Both *R. woodii* and *R. alexandrina* have now been elevated to specific rank and subspecies *segregata* has been found to be conspecific with *R. burchellii* K. Schum., and has consequently been reduced to synonymy under this species. *R. flanaganii* can be separated from its nearest relatives (those species mentioned above) by its bifariously pubescent stems, compact, sessile or subsessile inflorescences, and small outer corona lobes.

Riocreuxia flanaganii is restricted in distribution, being recorded from Grahamstown to Komga in the eastern Cape/ Ciskei and just enters southern Transkei. Near the sea, *R. flanaganii* is found growing on grassy slopes amongst boulders, whereas further inland it is usually found twining on tall grass and low shrubs in open veld. Being inconspicuous it is, like many other *Riocreuxia* species, often overlooked by plant collecters. *R. flanaganii* flowers in the midsummer months (November to February) and occurs from just above sea level to

600 metres. It is interesting to note that plants closer to the sea have smaller, hairier leaves.

The plate featured here was also used by R. A. Dyer to illustrate the front cover of his book Ceropegia, Brachystelma *and* Riocreuxia *in southern Africa*. Points well illustrated in this plate are the almost fleshy cylindrical roots, twiggy habit, long twining bifariously pubescent stems, compact sessile or subsessile inflorescences and short outer corona lobes.

DESCRIPTION.—Twining perennial herb with a cluster of subfleshy roots. *Stems* twining, up to 1 m or longer, bifariously puberulous. *Leaves*: petiole up to 4 cm long; blade cordate-ovate, acuminate, very variable in size, up to 8 cm long, glabrescent to puberulous. *Flowers* in compact, many-flowered, umbel-like fascicles, sessile or shortly pedunculate; pedicels 3–6 mm long, glabrous. *Sepals* lanceolate, up to 3 mm long, glabrous. *Corolla* 10–20 mm long; tube c. 5 mm long, subcylindric, more or less contracted at the mouth, glabrous, whitish or pale yellow; lobes linear-filiform, arched to the connate tips, c. 6 mm long, orange or dull yellowish at base, purple-brown above. *Corona* somewhat fleshy with 5 deeply divided outer lobes with the teeth or lobules face to face; inner lobes subulate or linear, 1 mm long, incumbent on the backs of the anthers and much exceeding them, yellow. (*A. Batten 559* in National Herbarium, Pretoria).—A. NICHOLAS.

ARTIST.—Auriol Batten.

PLATE 1991.—Fig. 1, rootsystem and base of stem, × 1; 2, flowering branch, × 1; 3, piece of stem showing bifariously arranged bands of hairs, × 1; 4, longitudinal section of corolla, × 5; 5, gynostegium (note the short outer lobes and longer inner lobes overtopping the staminal column), × 30; 6, pollinarium, × 60.


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Anne Battey

PLATE 2073

CEROPEGIA DECIDUA SUBSP. PRETORIENSIS

Transvaal

ASCLEPIADACEAE

Ceropegia decidua *E.A. Bruce* subsp. **pretoriensis** *R.A. Dyer* in Bothalia 12,4: 630 (1979); R.A. Dyer in Flora of southern Africa 27,4: 75 (1980); P.V. Bruyns in Aloe 18,1 & 2: 27 (1980); R.A. Dyer, *Ceropegia, Brachystelma* and *Riocreuxia* in southern Africa 211 (1983).

The protrayal of this plant in *The Flowering Plants of Africa* highlights the important contribution amateur botanists may make towards a better understanding of our flora. Due to increasing work loads and financial concerns, present-day taxonomists do not get out into the field as often as some of their predecessors. Time is therefore not readily spent to look for plants such as the cryptic ceropegias, of which *Ceropegia decidua* subsp. *pretoriensis* is one. I was thus delighted when Tony Hitchcock, a keen and knowledgeable amateur botanist, brought to my attention that this particular plant was flowering on his plot just east of Pretoria.

Ceropegia, Brachystelma and *Riocreuxia* form a generic complex with many interesting taxonomic problems at both the generic and specific levels. *Riocreuxia* is separated from the other two genera by having branched, and therefore non-umbelliform, inflorescences and more or less erect anthers. The pollinia are also pellucid at the apex rather than along the upper, inner margin and are attached to the corpusculum a little differently. *Ceropegia*, on the other hand, is separated from *Brachystelma* by the pronounced tubular flowers which are often inflated at the base. Mature plants are usually climbers or scramblers, and only occasionally dwarf in nature. These generic characters may break down if assigned singly (as in the case of *Riocreuxia flanaganii* Schltr.), but when taken together (that is as a correlated character combination set) they can be used to separate these three genera quite successfully.

Ceropegia has an interesting distribution. It is found on the Canary Islands, throughout Africa (including Madagascar), southern Arabia, India, throughout southeastern Asia into New Guinea and northern Australia. According to Dyer (1983), 51 of the over 160 known species in the genus occur in southern Africa. In Africa the genus has a considerable number of difficult species complexes, many of which still need detailed systematic investigation. Some of the southern

African species, such as *C. sandersonii* Decne. ex Hook. f. with large flowers and leaves are easily spotted while others, such as *C. decidua*, are not. Due to their camouflaged nature these plants are not often collected and this has tended to hamper taxonomic research in the genus. Finding these cryptic species proves a continual challenge to those interested in the group.

Ceropegia species with depressed-globose tubers, slender climbing habit and usually succulent leaves are distributed from southern Africa to India, but are especially common and widespread in South Africa. In this latter country they include the well known *C. africana* R. Br. and *C. linearis* E. Mey. These two species along with a number of others, including *C. decidua* subsp. *pretoriensis*, form one of the most intricate taxonomic complexes in the genus *Ceropegia*.

To deal adequately with the variation exhibited by *Ceropegia decidua*, Dyer found it necessary to create two subspecies: subsp. *decidua* and subsp. *pretoriensis*. This latter subspecies is illustrated here. In 1983 Dyer saw no reason for giving these two taxa more than subspecific recognition, even hinting that some taxonomists may find this distinction undesirable. Taken within the context of the genus, the characters used to separate these two taxa are not conservative in an evolutionary sense and are therefore taxonomically unimportant. In my experience they do not warrant specific rank under any currently held species concept. However, if we were to sink the two taxa we would be losing interesting morphological, phytogeographical and ecological information. Dyer's choice of rank is therefore considered ideal, and I have chosen to uphold his subspecific status for these two taxa.

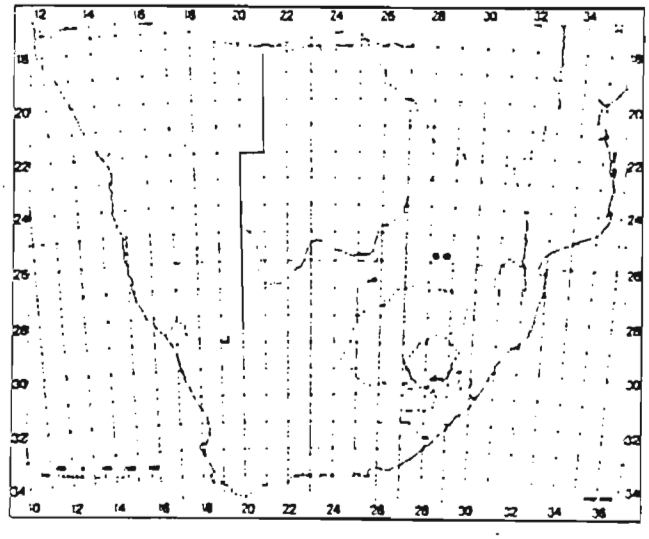
Having committed myself to Dr Dyer's taxonomic concepts I must also state that Dr Peter Bruyns has kindly pointed out that the classification accepted by me here may be erroneous and that *Ceropegia decidua* subsp. *pretoriensis* may, in fact, be conspecific with *C. fortuita* R.A. Dyer. and have little to do with *C. decidua* subsp. *decidua*. Dr Bruyns has worked on *Ceropegia* for many years now and his field work on the genus is almost without rival. I am inclined to agree that he may have a valid point concerning the taxonomic position of *C. decidua* subsp. *pretoriensis*, but have decided to leave the final decision and the valid publication of his findings to him.

Subsp. *decidua* can be distinguished from subsp. *pretoriensis* by the fact that it usually (but not always) drops its leaves before flowering. The corolla lobes are pinched or constricted in the middle only and broaden abruptly at their apices where they unite to form a small canopy. The lobe below the central constriction is flat on the inner surface and the margins are folded tightly against the outer face of the lobe; adjacent lobes touch each other along these folds for some

distance above their bases. Also, the corolla has five ridges running down its length, these ridges starting just below the lobe sinuses. Subsp. *decidua* occurs in what Acocks (1988, Veld types of South Africa, 3rd edn, *Memoirs of the Botanical Survey of South Africa* No. 57) referred to as Bushveld, in particular the thornveld components of this broad vegetation type. Subsp. *decidua* may be found sporadically from the northern Transvaal to the lower-lying, warmer parts of Swaziland.

In contrast, subsp. *pretoriensis* has persistent leaves, while the corolla lobes are loosely folded along the midrib for their whole length, which is especially noticeable in the lower two thirds or at least below the middle of the lobe. The lobes are not reflexed tightly towards the base and adjacent lobes do not touch, except at their very base. Although united at the tips, the lobes do not form a canopy and the corolla tube is without ridges. According to Bruyns (1981), subsp. *pretoriensis* is confined to rocky outcrops of the quartzitic Magaliesberg mountain series and will not be found growing on dolerite, dolomite or in flat areas.

Plants may be found growing in direct sunshine or in shaded situations. Tubers are initially turnip-shaped, but mature into a disc-like structure with white flesh. This tuber lies just below the humus level (usually sandy leaf mould). On rare occasions two or more young tubers may be found connected in series. From the tuber one or two long, thin stems are produced. The degree to which these stems climb depends on the support offered by the surrounding vegetation. This factor also governs the size of the basal leaves and length and leafiness of the flowering stem. Generally the above-ground parts of the plant do not die away completely during the dry season, and regrowth is initiated only after good rains. Most plants usually flower between January and February, although under ideal conditions plants have been recorded flowering as early as September and as late as April. Fruit generally starts to appear between February and April and, according to Bruyns, mature seeds are usually produced between May and July.



This plant is a Pretorian endemic. All present National Herbarium collections come from the 2528C and 2528D quarter degree grids (see map). They were all found growing at an average altitude of about 1 440 meters. Although still found within the Pretoria municipal bound-

aries, its habitat remains under threat from increasing urbanization. The introduction of exotic species into the rocky, hilly parts of Pretoria is at present the main culprit and to a lesser degree the erection of houses is also a threat. Although not in immediate danger of extinction, this plant's long term survival in its native habitat is doubtful.

The artist and author would like to thank Mr A. Hitchcock for his help and enthusiasm. Along with the referees we would also like to thank Dr Peter Bruyns for his invaluable comments and additions to the original manuscript.

DESCRIPTION.—*Rootstock* when mature a vertically depressed disc-like tuber, 20–40 mm diam. *Stems* usually 1, occasionally 2, produced from near the base, 0.20–0.75 m tall, twining if given the chance. *Leaves* usually persistent during flowering, often more abundant nearer the tuber; petiole 1.5–4.5(–6) mm; blade oblong-ovate to ovate, often not symmetrical, subfleshy, 12–30 × (6–)9–16 mm. *Flowers* in 2–4-flowered cymes, occasionally appearing 1-flowered due to abortion; peduncles 3–8 mm long; pedicels 2–5 mm long. *Sepals* linear-lanceolate, 1.5–2.5 mm long, glabrous. *Corolla* usually erect and tubular, 17–21(–25) mm long; tube 12–14(–18) mm long with subglobose spreading basal inflation, 4.0–6.5 × 2.5–5.0 mm, covered internally with papillae, slender above and not expanding at the mouth with slender deflexed hairs inside, dull purple to brownish pink with basal swelling pale green or greyish with brown blotches; lobes variable, linear to spathulate, 5–7 mm long, invariably pinched (with reflexed sides where pinched) in the lower two thirds or at least below the middle, outer face brownish pink, inner face deep purple, dark marginal cilia, tips united and brownish pink inside and out. *Corona*: outer margin 5-lobed and connate-campanulate, shallowly toothed or appearing crenulate along upper margin which is as high as or slightly higher than staminal column; inner lobes 5, arising from inside of outer campanulate margin, spathulate, ± 2 mm long, erect and convergent above staminal column with slightly dilated and noticeably reflexed apices. *Follicles* usually 2 per flower, occasionally 1 by abortion, more or less linear and erect, 60–68 × 2.5–5.0 mm. *Conservation status*: threatened. (*Condy 36* in National Herbarium, Pretoria, No. 60767.)—A. NICHOLAS*.

ARTIST.—Gillian Condy.

PLATE 2073.—1, fertile adult plant with tuber × 1; 2, flower × 4; 3, gynostegium showing details of corona × 10; 4, mature follicles × 1.

* Present address: Botany Dept, University of Durban-Westville, Private Bag X54001, Durban, 4000 South Africa.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Flowering Plants of Africa 55: 96–101 (1997)

Brachystelma natalense

Asclepiadaceae

South Africa

Brachystelma natalense *(Schltr.) N.E.Br.* in Flora capensis 4,1: 850 (1909); R.A.Dyer in Flora of southern Africa 27,4: 36 (1980); R.A.Dyer in *Ceropegia, Brachystelma* and *Riocreuxia* in southern Africa: 120–121 (1983); Ngwenya *et. al* in Aloe 32,2: 44–45 (1995). *Astostephanus natalensis* Schltr. in Bulletin de l'Herbier Boissier 4: 451 (1896). *Brachystelma inandensis* E.Phillips in Bothalia 4: 38 (1941) *nom. superfl.*

To date, 25 southern African species of *Brachystelma* have been illustrated in *Flowering Plants of Africa;* the text of 17 of these was prepared by Dr Robert Allen Dyer. Dr Dyer's interest in the group culminated in a revision of the closely related taxa *Brachystelma, Ceropegia* and *Riocreuxia* for the *Flora of southern Africa* (1980) and in the copiously illustrated book Ceropegia, Brachystelma *and* Riocreuxia *in southern Africa* (1983). This article is written in honour of Dr Dyer, to acknowledge his valuable contribution towards the classification of this challenging genus.

Flowering and fruiting material of *Brachystelma natalense* was first collected by John Medley Wood in 1883 at Inanda, north of Durban, and some 88 years elapsed before a second collection was made by Janet Gibson in the Pinetown area. In view of their special botanical interest in rare and endangered plants of KwaZulu-Natal, staff at the Natal Herbarium in Durban set out to rediscover this threatened species. In December 1994 they met with success, and the plate illustrated here was prepared from a fresh specimen collected by staff member Bethuel Sikhakhane. Unfortunately, due to a lack of fruit (see later), this organ had to be drawn from Wood's specimen.

Brachystelma natalense is a cryptic, geophytic herb with remarkably small flowers. It is one of the ten known species from southern Africa which possess a cluster or fascicle of fleshy cylindrical or fusiform roots. Along with *B. schizoglossoides, B. ramosissimum*, and *B. sandersonii*, it is characterized by having very small petals, never more than 4 mm long. *B. natalense* can, however, be separated from these other small-flowered species by its terete, pubescent stems, ovate-subcordate leaves, and the lack of papilla-like cilia on both the corolla and corona lobes.

PLATE 2138.—1, basal parts with fleshy roots, × 1; 2, flowering stem, × 1; 3, abaxial view of flower, × 6; 4, adaxial view of flower, × 6; 5, top view of gynostegium showing double corona, adpressed strap-like inner appendages and erect pollinaria, × 27; 6, pollinarium with round to oval pollinia topped by a short callose point, short translator arms and narrow, ventrally flattened corpusculum, × 70; 7, mature follicle on elongated pedicel, × 1. Voucher specimens: *Wood 410* (flowering and fruiting material) and *Sikhakhane 528* (flowering material) in Natal Herbarium, Durban. Artist: Elsa Pooley.

FIGURE 1.—Known geographical distribution of *Brachystelma natalense*.

It is possible that the fascicle-rooted *Brachystelma* species (to which *B. natalense* belongs) had a different origin to the tuberous species. Some members of the fascicle-rooted group (which are extremely diverse in their vegetative and floral morphology) share several features with the closely related genera *Anisotoma* and *Macropetalum*, and might very well form a closer relationship with these than with the other tuberous *Brachystelma* species. In support of this, we cite Schlechter's (1896) arguments and Brown's (1909) comment that the corona lobes of *B. schizoglossoides* can scarcely be distinguished from those of *Anisotoma*; making the unusual habit of this latter genus, with its long, decumbent, creeping stems, the only distinguishing feature. The tuberous *Brachystelma* species, on the other hand, seem to form a sister group to *Ceropegia*. Species such as *B. gymnopodum* (Schltr.) Bruyns (recently transferred from *Ceropegia*) and *C. mafekingensis* (N.E.Br.) R.A.Dyer (recently transferred from *Brachystelma*) almost form a continuum between the two genera.

Should the fascicle-rooted *Brachystelma* species prove to be monophyletic (a fact which still needs to be established), and to have arisen from a different ancestor to the tuberous types, then a new genus will need to be erected for them. Fortunately several names are available, all with type species in this group, viz.: *Dichaelia* Harv. (1868), *Lasiostelma* Benth. (1876) and *Aulostephanus* Schltr. (1896). The oldest name, *Dichaelia*, has recently been resurrected by Bullock (1953, Notes on African Asclepiadaceae III, in *Kew Bulletin* 1953: 329–362) and Huber (1967, Asclepiadaceae, in *Prodromus einer Flora von Südwestafrika* 19,114: 28). The present authors are, however, reluctant at this point to accept these changes, because the nature and extent of homoplasy and monophyly must first be established within that broad group of related genera comprising *Brachystelma*, *Ceropegia*, *Riocreuxia*, *Macropetalum*, *Anisotoma*, *Sisyranthus* and *Tenaris*.

Brachystelma natalense, a slender-stemmed species, is endemic to the coastal escarpment grasslands of KwaZulu-Natal, just inland from Durban. The species appears to be restricted to the 2930 grid (Figure 1).

Flowering occurs from October to February with a peak in November and December. Grazing of the main axis tends to reduce its height to about 50–120 mm and results in two or more lateral stems that give the plant a multi-

stemmed appearance. Unfortunately, grazing of flowers also prevents seed production, which may account for the scarcity of this species. Ten flowers were hand-pollinated in an attempt to produce fruit and seed. In order to ward off herbivores, plants with hand-pollinated flowers were sequestered with shade cloth about 700 mm high. The hand-pollinated flowers, however, failed to set seed. Perhaps, amongst other things, the time for pollen transfer was not correctly chosen. Furthermore, the very small flowers made hand-pollination particularly difficult.

We have listed the conservation status of this restricted, endemic plant as endangered. This was done because it is at present known only from two localities (the type locality probably having been destroyed), one of which contains a mere 57 plants in an area of 600 m^2. The long-term survival of this population, which is heavily grazed and has not recently produced seed, is doubtful. Other populations, if they exist, probably occur within the Greater Durban Metropolitan area, and would, as a result, be threatened by the conurbational proliferation and consolidation that accompanies ever-increasing population growth. Although not suitable as an ornamental, the rarity of *Brachystelma natalense* gives it value. In an attempt to save it from almost certain extinction the appropriate authorities should be encouraged to facilitate its introduction onto the horticultural market via *ex situ* breeding programmes.

The generic name *Brachystelma* is derived from the combination of the Greek words *brachy* (= short) and *stelma* (= crown), and alludes to the small corona. The specific epithet *natalense* refers to the fact that the plant is a native of Natal, now the KwaZulu-Natal Province. When Nicholas Edward Brown (1908) transferred this species to *Brachystelma* (a genus which is neuter) he changed Schlechter's suffix *-ensis* (which is both masculine and feminine) to *-ense* (which is neuter) so that the specific epithet would agree with the gender of the genus to which it was transferred. This is in accordance with recommendation 60D.1 of the 1994 version of the *International Code of Botanical Nomenclature* (*ICBN*) which states that an epithet derived from a geographical name should preferably be an adjective. Brown treated the name in the nominative singular (i.e. 'the Natal *Brachystelma*'). He could equally have treated it in the genitive singular (i.e. 'the *Brachystelma* of Natal'), in which case it would have been declined back to *natalensis*, a situation actually preferred by the *Code*. A third option, and one discouraged by the *ICBN*, is to use the ablative singular (i.e. 'the *Brachystelma* from Natal'), in which case *natalensis* would be declined to *natalensi*.

Description.—Cryptic, perennial, geophytic herb with a cluster of 7–10 swollen, fusiform roots. *Stem* single, slender, erect, terete, produced annually, mostly 250–500 mm high, ± 3–4 mm thick towards base, densely pubescent with multicellular hairs. *Leaves* opposite, ovate to orbicular, 20–45 × 10–35 mm, becoming progressively smaller upwards, ciliate with white hairs on

both surfaces, margins and apex pink; petiole up to 50 mm long. *Inflorescences* 2–5-flowered, extra-axillary, from upper nodes of stem, 10–25 clustered towards apex; pedicels slender, up to 25 mm long, pink, puberulous, becoming more robust when in fruit; bracts lanceolate, up to 2 mm long, pubescent on outer surface. *Flowers* rotate, 3–4 mm in diameter, 2–3 mm high. *Calyx* 5-lobed, linear-triangular, finely acute and margins incurved, ± 2.5 mm long, pink, outer surface puberulous, inner glabrous; glands in sinus of sepal lobes 0.25 mm long. *Corolla* 5-lobed, lobes fused basally to form a shallow cup-like tube, lobes spreading, ovate, 3 mm long, ± 1.25 mm wide, glabrous on both surfaces, outer surface green, inner yellow. *Corona* yellow, glabrous, in 2 whorls; outer corona opposite petals, of 5 bifid lobes, inner corona alternating with petals, 5-lobed, lobes consisting of a cucullate basal extension from which emerges a strap-like, slightly concave appendage projecting over and adpressed to stigma-style head. *Anther wing* small, with a distinct large step midway up its length. *Pollinarium*: pollinia erect, 0.15 mm long, 0.1 mm wide, brown, with a short apical callose protrusion; translator arms short, ± 0.025 mm long; corpusculum ± 0.1 mm long. *Stigma-style head* white, slightly concave. *Follicle* 1 by abortion, ± 100 mm long, subfusiform, smooth; peduncle elongated to ± 45 mm. *Seeds* not seen. *Ecology*: growing in coastal grasslands (Ngongoni veld), on sandstone mountain escarpment; subject to biennial burning, and browsed by unidentified small mammals. *Pollination biology*: pollinators unknown. *Ethnobotany*: no known medicinal or economic uses. *Conservation status*: endangered. Plate 2138.

Y. SINGH*, A. NICHOLAS** and ELSA POOLEY***

* Natal Herbarium, National Botanical Institute, Botanic Gardens Road, Durban, 4001 South Africa.

** Department of Botany, University of Durban-Westville, Private Bag X54001, Durban, 4000 South Africa.

*** P.O. Box 295, Scottburgh, 4180 South Africa.

Plate 2138 *Brachystelma natalense*

S. Afr. J. Bot. 1998, 64(3) 205–208

In defence of *Tenaris* and *Macropetalum* (Asclepiadaceae)

Janine E. Victor* and A. Nicholas†

*National Herbarium, National Botanical Institute, Private Bag X101, Pretoria, 0001 Republic of South Africa

†Department of Botany, University of Durban-Westville, Private Bag X54001, Durban, 4000 Republic of South Africa

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The Asclepiadaceae *s.str.* have been the subject of much attention in recent years, with many changes having been made at the generic level. The recent placement of *Tenaris* and *Macropetalum* into synonymy under *Brachystelma* is questioned. In this article, the merits of this decision are critically assessed and rejected. All three former genera are re-instated and new name combinations are made. A synopsis of the taxa of *Tenaris* and *Macropetalum* is provided with the hope of clarifying their taxonomic concepts.

Keywords: Asclepiadaceae, *Brachystelma*, *Macropetalum*, Taxonomy, *Tenaris*.

*To whom correspondence should be addressed, e-mail: jev@nbipre.nbi.ac.za

Introduction

The taxa of the Asclepiadaceae *s.str.* have been subjected to much taxonomic shuffling since the family's creation by Robert Brown in 1810, with little generic stability having been achieved since then (Nicholas 1989). This has been especially noticeable over the last few decades within the tribes Stapelieae and Asclepiadeae (Nicholas & Goyder 1990). Researchers, both amateur and professional, often have conflicting, and usually vociferous, opinions as to how various genera of the Asclepiadaceae should be classified, playing havoc with the taxonomic hierarchy. A recent example is the placement of *Tenaris* E. Mey. and *Macropetalum* Decne. into synonymy under *Brachystelma* R. Br. (Peckover 1996). In this paper we explore and discuss the merits of these particular changes.

Discussion

Peckover (1996) criticised Bruyns's (1995) interpretation of the genus *Macropetalum* on the basis of two inconsistent characters which he used to distinguish it. However, it appears that Peckover misunderstood the aim of Bruyns's paper. The characters which Bruyns used to distinguish this genus from *Tenaris* (stems and exterior of corolla glabrous) are key characters used for identification purposes and not important diagnostic characters of classificatory or evolutionary significance. Peckover (1996) stated that these characters were 'not consistent' and could, therefore, not be used to distinguish it from *Tenaris*, and on this basis combined *Macropetalum* with *Brachystelma*.

Dyer (1975) distinguished *Macropetalum* on the basis of it having corona lobes in one series, on or below the back of the anthers, not connected at the corolla base. *Brachystelma*, *Ceropegia* L. and *Tenaris*, on the other hand, have corona lobes in two series, or falsely in one series of 3-fid lobes, the outer series sometimes reduced to small pouches, or slits, between the inner series opposite the anthers. The position and structure of the corona of *Macropetalum* (which is actually pseudouniseriate rather than uniseriate), as well as its relationship to the enlarged gynostegial head, are unique in the Asclepiadaceae (Brown 1908). When this unique and presumably derived character is combined with features such as the long, wholly reflexed corolla lobes, extremely exposed gynostegial column and laterally placed anthers with conspicuous erect appendages, it becomes difficult to justify placing this genus into *Brachystelma*, even though they may have evolved from the same distant common ancestor. The floral differences seen in *Macropetalum* are probably due to some unique pollination syndrome not found in other species of *Brachystelma* and, in our judgement, are important enough to warrant recognition at the generic level. Even Peckover (1993) admits to the significance of these differences, saying that *Macropetalum* is 'an unusual plant which is unique amongst the stapeliads, especially with regard to its floral form'.

Peckover (1996), however, later appeared to have changed his mind, sinking *Macropetalum* into *Brachystelma*. He attempts to justify this change by comparing morphology within a genus which is heterogeneous (and possibly polyphyletic). Thus the range of character variation is so vast that one can justify sinking almost anything into it. As a result, such taxa become taxonomic 'black holes' sucking in all surrounding genera. Peckover (1996) states that he has attempted to create a system in which only *Ceropegia* and *Brachystelma* would be recognised for 'this group' of related genera. However, following through with this logic, structurally transitional species such as *Ceropegia nuptiengensis* (N.E. Br.) R.A. Dyer and *Brachystelma gymnopodum* (Schltr.) Bruyns make this impossible to achieve and would require the sinking of *Brachystelma* under the older name *Ceropegia*! The range of variation in *Ceropegia* would then be such that it would no longer be possible to justify the retention of *Riocreuxia* Decne., *Anisotoma* Fenzl and possibly even *Stayneria* E. Mey. as separate genera. The subtribe Ceropeginae in southern Africa would become an unwieldy, meaningless genus - which would probably end up being split into a series of sections and subgenera based on many groups now in existence at the generic level.

Another factor apparently not taken into account by Peckover (1996) is that homoplasy is (because of similar pollination pressures) fairly common in the Asclepiadaceae - a situation accentuated in large paraphyletic or polyphyletic taxa. Hence, to compare the complete synorganisation of the outer and inner corona lobes in *Macropetalum* with the same trend seen in *Brachystelma blepharanthera* Huber (which is a short plant, with spathulate leaves, campanulate corolla with short spreading erect lobes and linear-clavate inner corona lobes) is, in its evolutionary significance, like comparing the reduction of the petal whorl in grasses with that in sedges. The phenomenon is of interest, but being non-homologous, cannot be used to lump the Poaceae with the Cyperaceae. Such comparisons become relevant only when they are made between taxa that are known, or at least suspected, to be closely related, and in which the characters compared have not come about due to parallel or convergent evolution. Only

then can the comparison take on any classificatory significance.

In consequence of the above discussion, the genus *Macropetalum* is still recognised as a distinct taxon at the National Herbarium, Pretoria.

Tenaris E.Mey.

This genus is slightly more difficult to define than the closely allied *Macropetalum*. *Tenaris rubella* E. Mey., on which Meyer (1837) established the genus, is quite distinct from *Brachystelma*. This species is immediately distinguished by its leafless, terminal raceme or panicle-like inflorescence, bright pink flowers, and long spreading, spathulate corolla lobes; see the figure given in Harvey (1859). Bullock (1954) sunk *T. rostrata* N.E. Br. and *T. simulans* N.E. Br. under *T. rubella*. However, it is suspected that this broad interpretation may need to be abandoned if critically re-examined. The later addition of species such as *T. filifolia* N.E. Br. and *T. chloranthа* Schltr. (Brown 1908), which have leafy, plainly racemose inflorescences, purple-browny green flowers and filiform corolla lobes, clearly alters the circumscription of the genus as envisioned by Meyer, and creates problems as *Tenaris* now begins to merge with the graminoid species of *Brachystelma*. However, these newly included species are clearly more closely related to *T. rubella* having in common the same slender habit, short corolla tube and small biseriate or double corona arising above the corolla base, and consisting of concave outer lobes and linear, incumbent inner lobes. In their overall features, especially floral, they are more closely related to *T. rubella* than to the graminoid species of *Brachystelma*. It is probably for this reason that Bruyns (1995) commented that "there appears to be a case for maintaining *Tenaris* as distinct from *Brachystelma* provided it is confined to the seven species of Brown", and why it has been maintained as distinct by Malaisse (1985), Brummitt (1992) and Liede and Albers (1994).

The only other species of *Brachystelma* in southern Africa that resemble *Tenaris* are *B. gracile* E.A. Bruce and *B. schulzei* (Schltr.) Bruyns. However, *B. gracile*, which is notoriously variable (Meve 1993), can be immediately distinguished by the fact that it has no corolla tube, a reflexed calyx, corolla lobes that are usually (except in pressed material) connate apically, and quite a different corona structure, the outer lobes being large and deeply bifid, the inner lobes spathulate (and sometimes emarginate) and incumbent-erect above the anthers. For a more detailed description, see Dyer (1980 & 1983) and Meve (1993), the latter with an illustration.

Brachystelma schulzei, from Namibia, was placed in *Tenaris* without comment by Phillips (1941). It superficially resembles *Tenaris* in its stem tuber, habit, few-flowered, leafy, racemose inflorescences, very short corolla tube and long, linear corolla lobes, but this similarity may be either plesiomorphic or due to homoplasy. The corolla lobes differ in being puberulous on both surfaces, and almost ciliate at the expanded base where it forms the mouth of the shallow corolla tube, this being reminiscent of certain species of *Sisyranthus*. The corona is almost pseudomonoseriate, with small deltoid, slightly bifid outer corona lobes alternating with long, erect, filiform and connivent inner lobes with tips reflexed. In many ways, the corona is more like that of some species of *Ceropegia* than those of *Brachystelma*, and this is why Schlechter (1913) erected the genus *Kinepetalum* for it. Also, unlike *Tenaris*, the gynostegium may be exserted as is seen in some species of *Brachystelma* and in *Macropetalum*. Phylogenetically, this strange combination of characters from several genera could indicate that *B. schulzei* is near the base of the subtribe, viz. stem Ceropeginae rather than crown Ceropeginae. However, most of its features seem to place it within *Brachystelma* but basal to the tuberous species. However, this must remain speculative and we hope it will be tested in time using molecular and cladistic studies within the subtribe.

In consequence of the above discussion, the genus *Tenaris* is still recognised as distinct at the National Herbarium, Pretoria.

Conclusion

Evidence available indicates that *Brachystelma* is heterogeneous, and probably polyphyletic. However, a solution is unlikely to be found using purely classical methods. As a result, it is hoped that molecular systematic work and cladistic analysis will eventually be brought to bear on the problem. Although affinities of the genus *Tenaris* are, without doubt, close to some of the tuberous species of *Brachystelma*, they form a coherent group of taxa based on a unique suite of correlated characters (see below). The genus *Macropetalum*, although similar to *Tenaris* in its habit and long filiform corolla lobes, is clearly distinct in its floral and coronal structure from all other genera of the Asclepiadaceae and therefore, like *Tenaris*, it warrants generic status.

Formal taxonomy

Key to genera of the subtribe Ceropeginae in southern Africa

Owing to its structural heterogeneity, *Brachystelma* keys out at several points.

1a. Flowers with corolla tube long and cylindrical 2
1b. Flowers with corolla tube cupulate, campanulate or absent ... 6
2a. Corolla lobes up to 3 mm long ..... *Brachystelma*
2b. Corolla lobes usually longer than 4 mm 3
3a. Corona monoseriate ..... *Orbanthera*
3b. Corona biseriate 4
4a. Leaves absent, or linear to ovate; if large, then not heart-shaped ..... *Ceropegia*
4b. Leaves broad (> 20 mm) and long (50–120 mm), heart-shaped with cordate base 5
5a. Corolla asymmetrical or with bottle-neck-like constriction near lobes; corolla lobes with long white or purple cilia or at least pubescent ..... *Ceropegia*
5b. Corolla symmetrical and without a bottle-neck-like constriction near lobes; corolla lobes glabrous ..... *Riocreuxia*
6a. Plants with stems trailing along the ground or climbing 7
6b. Plants with stems more or less erect and unsupported 9
7a. Petioles longer than 25 mm ..... *Emplectanthus*
7b. Petioles shorter than 20 mm 8
8a. Plants with leaves heart-shaped and cordate at the base; rootstock deep-seated and woody; corona over-topping the style-stigma apex ..... *Anisotoma*
8b. Plants with leaves never heart-shaped and cordate at base; rootstock a stem tuber; corona not over-topping style-stigma apex ..... *Brachystelma*
9a. Plants graminoid, with thin erect stems not noticeably hairy 10
9b. Plants not graminoid, if taller than 650 mm, then leaves never linear and noticeably hairy 14
10a. Plants with fascicled roots 11
10b. Plants with stem tubers 12
11a. Corona monoseriate; anther appendages present and usually with a few long white hairs ..... *Sisyranthus*
11b. Corona biseriate; anther appendages obsolete or if present, then without hairs ..... *Brachystelma* (e.g. *B. longifolium* & allies)
12a. Corolla lobe tips connate forming a cage around gynostegial column ..... *Brachystelma gracile* & *B. xerophyllum*
12b. Corolla lobe tips never connate, usually spreading to reflexed 13
13a. Corona monoseriate or pseudomonoseriate with lobes adnate to staminal column up to anther lobes, then free above; anthers with erect membranous appendages ..... *Macropetalum*

13b.Corona biseriate, not adnate to but arising from just above staminal column base; anthers without appendages .... *Tenaris*
14a.Leaves with petioles longer than 20 mm; corona monoseriate or pseudomonoseriate ..... *Riocreuxia aberrans*
14b.Leaves with petioles never longer than 18 mm; corona lobes noticeably biseriate ..... *Brachystelma* (e.g. *B. gracillimum* & allies)

Reinstated genera

Macropetalum Burch. ex Decne. in DC. Prodr. 8: 626 (1844). Type species: *Macropetalum burchellii* Decne.

This genus can be defined by the following unique, correlated suite of characteristics:

Slender, erect plants up to 1 m high, with branched (usually from near the base) or unbranched stems, produced from a discoid stem tuber. Leaves linear, up to 3 mm wide, up to 100 mm long, usually shorter than, or as long as, the internodes. Inflorescences 4–7-flowered. Flowers facing down. Petals completely free, wholly reflexed from receptacle base at anthesis, thus exposing and presenting gynostegial column. Corona pseudomonoseriate, produced from base of gynostegium where it is adnate to staminal curtain, with lobes free, linear-lanceolate, erect and recurved epically completely over-topping gynostegium. Anthers lateral on stout style-stigma head with conspicuous, erect anther appendages. The genus is monotypic and found only in the central and eastern parts of the southern African subcontinent.

Macropetalum burchellii Decne. in DC. Prodr. 8: 626–627 (1844).
Brachystelma burchellii (Decne.) Peckover: 43 (1996).
Note: This species can be divided into two varieties.

Variety *burchellii*
Corolla whitish or greenish white, up to 30 mm long. Without small teeth on upper edge of recurved corona lobes.

Variety *grandiflora* N.E. Br. in Fl. Cap. 4(1): 799 (1908).
Corolla yellow-green, yellowish or even somewhat orange, longer than 31 mm. With small teeth on upper edge of corona lobes which are not recurved.

Excluded taxa

Macropetalum benthamii K. Schum. in Engl. & Prantl. Naturl. Pflanzenfam. 4(2): 266 (1897). = *Tenaris rubella* E. Mey. Comm. Pl. Afr., 1837: 198.

Macropetalum filifolium Schltr. in Engl. Bot. Jahrb. 38: 36 (1907). = *Tenaris filifolia* (Schltr.) N.E. Br. Fl. Cap. 4(1): 797 (1908).

Tenaris E. Mey. Comm. Pl. Afr.: 198 (1837). Type species: *Tenaris rubella* E. Mey. The genus is based on the following unique, correlated suite of characters:

Stem tuber discoid to globose, producing long, slender, erect stems that are simple or much branched from near base. Leaves linear, shorter than, or as long as, the internodes. Flowers in pairs, or up to 7. Corolla tube short. Corona small, biseriate, arising from staminal curtain above its base, outer corona lobes concave and ± spreading, inner corona lobes linear and incumbent on back of anthers, and anther appendages ± absent. This combination of characters suggests that the species of *Tenaris* outlined below form a coherent group, and probably arose from a common ancestor. The genus is composed of five species.

Key to the species of *Tenaris*:

1a. Corolla lobes linear-spathulate, pink ..... *T. rubella*
1b. Corolla lobes filiform or linear-filiform, green, yellow, purple or brown 2
2a. Species found in Zimbawe ..... *T. bikitaensis*
2b. Species found in South Africa 3
3a. Inner corona lobes much longer than anthers..... *T. filifolia*
3b. Inner corona lobes shorter than or subequalling anthers 4
4a. Flowers > 25 mm in diameter ..... *T. christianeae*
4b. Flowers < 20 mm in diameter ..... *T. chlorantha*

1. *Tenaris rubella* E. Mey. Comm. Pl. Afr.: 198 (1837).
Brachystelma rubellum (E. Mey.) Peckover: 43 (1996).
Tenaris rostrata N.E. Br.: 473–474 (1903).
Tenaris simulans N.E. Br.: 796 (1908).
Tenaris volkensii K. Schum.: 327 (1895).
Note: This is the type species of the genus. With further investigation, *T. rostrata* and *T. simulans* may prove to be distinct and may need to be reinstated.

2. *Tenaris chlorantha* Schltr. in Engl. Bot. Jahrb. 20: Beibl. 51: 44 (1895).
Brachystelma chloranthum (Schltr.) Peckover: 43 (1996).
Macropetalum benthamii K. Schum.: 266 (1897).

3. *Tenaris filifolia* (Schltr.) N.E. Br. in Fl. Cap. 4(1): 797 (1908).
Macropetalum filifolium Schltr.: 36 & fig. 4. (1907). Please note that the corona structure is not accurately depicted in this figure.
Brachystelma filiformis (N.E. Br.) Peckover: 43 (1996).

4. *Tenaris christianeae* (Peckover) J.E. Victor & Nicholas, comb. nov.
Brachystelma christianeae Peckover in: Aloe 29: 56 (1992). Holotype: Nkandla, KwaZulu-Natal, R.G. Peckover 141 (PRE).

5. *Tenaris bikitaensis* (Peckover) J.E. Victor & Nicholas, comb. nov.
Brachystelma bikitaensis Peckover: in Aloe 32: 78 (1995) (Please note that captions for figures 2a and 2b are incorrect, and should be switched around).
Holotype: Zimbabwe, R. G. Peckover 242 (PRE).

Excluded taxa

Tenaris somalensis (Schltr.) N.E. Br. in Fl. Trop. Afr. 4(1): 473 (1903).
Lasiostelma somalense Schltr.: 61 (1899).
Tenaris somaiensis was suggested by Peckover (1996) to have fusiform rootstocks, however, we have been unable to confirm this. Gilbert (pers. comm.) has informed us that the type of *T. somalensis* is actually a detached inflorescence of *Caralluma priogonium*.

Tenaris subaphylla (K. Schum.) N.E. Br. in Fl. Trop. Afr. 4(1): 473 (1903).
Brachystelma subaphyllum K. Schum.: 40 (1898).
Gilbert (pers. comm.) has kindly informed us that *Tenaris subaphylla* is probably conspecific with *Ceropegia botrys*. We have therefore excluded it from *Tenaris* until this is verified.

Tenaris browniana S. Moore. Excluded owing to the possession of fusiform roots.
Possibly belongs to *Brachystelma*.
4. *Tenaris schuitzei* Schltr. = *Brachystelma schultzei* (Schltr.) Bruyns.

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SARCOSTEMMA

(ASCLEPIADACEAE)

- A GENUS DIVIDED?

BY
A. NICHOLAS & D.J. GOYDER
Herbarium,
Royal Botanic Gardens, Kew,
Richmond, Surrey.

ROYAL BOTANIC GARDENS KEW

INTRODUCTION

In 1950, an American botanist, Holm, sunk *Oxystelma*, *Philibertia*, *Funastrum*, *Pentacyphus* and *Tetraphysa* into the genus *Sarcostemma*. In essence, Holm had merely followed Woodson's 1941 treatment which was, in turn, an adaptation of concepts first proposed by Kunth in 1819. Although Holm's revision of his now expanded genus *Sarcostemma* was thorough, meticulous and detailed, his taxonomic concepts were not universally accepted. In particular, A.A. Bullock (1956), a prominent British asclepiodologist disagreed with Holm's taxonomic conclusions and, instead, followed Schlechter's 1914 classification, which was based on a synthesis of ideas by R. Brown (1809), Fournier (1882) and Bentham (1876). Bullock maintained all those genera sunk by Holm as separate distinct entities, and used *Sarcostemma* in its narrow sense as exemplified by *S.viminale*.

The Holmian and Bullockian schools of thought persist to this day, some 40 years after their proposal, with almost equal numbers of botanists using each system of classification. The two systems had to be assessed critically in connection with the authors' research into the Asclepiadaceae for various African Floras. As a result herbarium material at the Royal Botanic Gardens, Kew, and all relevant literature were consulted.

The two monotypic genera *Pentacyphus* Schltr. and *Tetraphysa* Schltr. were briefly studied. However, due to inadequate material no morphological and geographical data on them were included in the final analysis. The fact that they are unusual taxa, however, seems to be admitted by all. Even Holm, although he included them in their own section under *Sarcostemma*, admitted that they differ markedly from the other taxa and at one stage referred to them as "Rather perplexing..." Although not included in our analysis, it must be stressed that their exact status should be established in any comprehensive study of the *Sarcostemma* generic complex of which they are probably a part. Additionally, the monotypic, Madagascan genus *Platykeleba*, which was sunk into *Sarcostemma sensu* Holm by Descoings (1961), has been included in this study.

CHARACTER DISTRIBUTIONS

CHARACTER	*OXYSTELMA*	*PLATYKELEBA*	*PHILIBERTIA*	*SARCOSTEMMA*	*FUNASTRUM*
SUCCULENT	No	Yes	No	Yes	No
LEAVES	Present	Absent	Present	Absent	Present
TWIGGY	No	Yes	No	Yes	No
PEDUNCLES	Present	Absent	Present	Absent	Present
INFLORESCENCE	Cymose	Umbelliform	Cymose	Umbelliform	Umbelliform
FLOWER NUMBER	1—3(-5)	1—3	7(-10)	5—10(-20)	(18-)20—30
COROLLA LOBES	N/A	N/A	N/A	Replicate	Not Replicate
RING OF COROLLA HAIRS	Present	Absent	Absent	Absent	Absent
COROLLA	Campanulate	Campanulate	Campanulate	Rotate	Rotate
INNER CORONA	Claw-like	Peg-like	Claw-like	Globose	Globose
OUTER CORONA	Collar-like; staminal	Cupular; staminal	Collar-like; coralline, rarely very shortly staminal	Cupular; staminal	Cupular; staminal
FOLLICLES	Fusiform & Ovoid	?	Rostrate	Fusiform	Fusiform

DISCUSSION

From the above morphological data and distribution evidence, it became clear that we were dealing with five distinct taxonomic entities. The problem arose regarding whether we should recognize them at the generic level (Bullock) or subgeneric level (Holm). Unfortunately, if we apply the same habit, corolla and coronal criteria with equal force to other closely related taxa we would also have to sink *Pergularia*, *Pentatropis*, *Blepharodon*, *Cynanchum* and *Pentarrhinum* into an even more expanded *Sarcostemma*. As a consequence of this, *Pergularia* L., being the oldest name, would have to take priority, a state of affairs Holm himself said was undesirable (viz.: "Decidedly it does not seem

advisable to complicate further the synonymy of the sarcostemmas by changing them all to *Pergularia")* thus showing that he was aware of the situation and his own taxonomic bias on the matter.

It was also evident to us that Holm's description of *Sarcostemma* did not take into account *Pentacyphus* or *Tetraphysa* even though these were included by him. Including them in *Sarcostemma* (*sensu* Holm) would alter the generic circumscription so much that the range of variation inside *Sarcostemma* would be as great as (and include some of) the variation exhibited by surrounding, closely related genera.

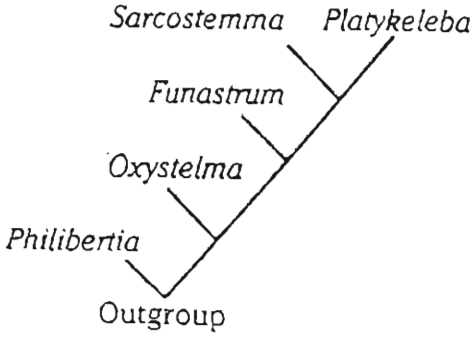
The separate genera, as outlined by Bullock, can be defined by distinct sets of correlated characters separated by obvious discontinuities. This not only leads to clearly circumscribed genera, but enables a multiple character key, such as the one below, to be constructed:

A. Inflorescences cymose; inner corona lobe (vesicle) claw-like .....B
AA. Inflorescences umbelliform; inner corona lobe (vesicle) globose or peg-like C
B. Inflorescences 1—3(-5) flowered; corolla with circumgynostegial ring of hairs.....*Oxystelma*
BB. Inflorescences 7(-10) flowered; corolla without circumgynostegial ring of hairs.....*Philibertia*
C. Plants succulent and apparently leafless; inflorescences lacking peduncles .....D
CC. Plants not succulent and quite leafy; inflorescences pedunculate .....*Funastrum*
D. Inflorescences 5—10(-20) flowered; corolla rotate (petals free); inner corona lobe (vesicle) globose .....*Sarcostemma*
DD. Inflorescences 1—3 flowered; corolla campanulate (petals fused); inner corona lobe (vesicle) peg-like .....*Platykeleba*

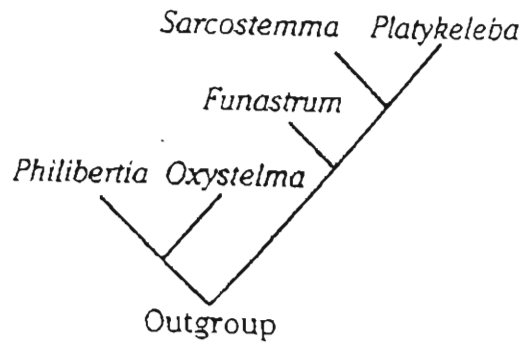
Possibly not evident from the discussion above is the fact that the authors have a certain amount of empathy with Holm's classification, for it is probable that the above five genera arose from the same ancestral roots within the Asclepiadaceae. To assess possible relationships between them, a cladistic study, based on the information in the above table, was carried out using Hennig86. The genus *Pachycarpus* was used as the outgroup. Two parsimonious trees were obtained.

Cladogram Length = 29. CI = 75 RI = 56

CLADOGRAM 1



CLADOGRAM 2



Cladogram 2 conforms with the authors opinions (based on a study of vegetative and floral morphology) that *Philibertia* and *Oxystelma* are more closely related to each other, and that *Funastrum*, *Sarcostemma* and *Platykeleba* tend to fall together into another (albeit closely related) group. Both cladograms, however, indicate that the campanulate corolla is a homoplasious character which should, therefore, be treated with caution.

CONCLUSION

The most useful classification is the one that carries the most easily accessible and logically presented information on taxa, their characters, character correlations and phylogeny. Using these criteria, the data accumulated during this study and the fact that the generic level is an important point of focus in the taxonomic hierarchy, Bullock's classification of *Sarcostemma* and allied genera has been judged to be the most useful one to date.

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A CLADISTIC INVESTIGATION OF THE GENUS *BRACHYSTELMA* R. Br. (ASCLEPIADACEAE) AND ITS ALLIES

A. NICHOLAS*, Y. SINGH and H. BAIJNATH***

*University of Durban-Westville, Durban, South Africa

**National Botanical Institute, Natal Herbarium, Durban, South Africa

Introduction

Classification of the closely related genera *Brachystelma* R. Br. *Ceropegia* L. (Figure 1) has been problematic for sometime. The apparent intergradation between the two can be seen in species such as *Brachystelma mafekingensis* N.E. Br., recently transferred to *Ceropegia* (Dyer 1977) and *Ceropegia pygmaea* Schinz, recently transferred to *Brachystelma* (Bruyns 1995) as *B. gymnopodum* (Schltr.) Bruyns. In general, the circumscription of *Ceropegia* has remained fairly consistent. This, however, cannot be said of *Brachystelma* which has been viewed by some taxonomists to comprise several distinct genera, viz. *Aulostephanus* Schltr., *Brachystelmaria* Schltr., *Blepharanthera* Schltr., *Craterostemma* K. Schum., *Decaceras* Harv., *Dichaelia* Harv., *Lasiostelma* Benth., *Micraster* Harv., *Siphonostelma* Schltr., and *Tapeinostelma* Schltr. Although, these names are now accepted as synonyms of *Brachystelma*, some workers have begun to wonder whether the genus is paraphyletic or even polyphyletic. Recently, for instance, the name *Dichaelia* has even been resurrected by certain authorities (Bullock 1953 and Huber 1967) for species of *Brachystelma* having corolla lobes connate at the tips. In particular, the authors of this paper have begun to consider the possibility that the fascicle-rooted species may have had a different evolutionary origin to the tuberous species. *B. natalense* (Schltr.) N.E. Br. (Figure 1) and *B. schizoglossoides* (Schltr.) N.E. Br. share several features in common with the closely related genus *Anisotoma* Fenzl and, to a lesser extent, *Sisyranthus* E. Mey (Figure 1). It has been speculated by Singh and Nicholas (paper in press) that these species may very well form a closer relationship to *Anisotoma* and *Sisyranthus* than to the tuberous brachystelmas. It must, however, be

pointed out that the ten fascicle-rooted species of *Brachystelma* are extremely diverse (Bruyns pers. com.). The situation is further complicated by the fact that:

- *Tenaris* E. Mey. appears to intergrade with *Brachystelma* (Peckover 1992) and has recently been sunk (along with *Macropetalum* Burch. ex Decne.) into this genus (Peckover 1996),
- *Riocreuxia* Decne. (Figure 1) is almost confluent with *Ceropegia* (Huber 1957), and;
- *Macropetalum* is almost confluent with both *Tenaris* (Bruyns 1995) and *Brachystelma*.

To investigate the hypotheses that the fascicle-rooted brachystelmas may be monophyletic and have arisen from a different ancestor to the tuberous species, and that *B. natalense* and *B. schizoglossoides* are related to *Anisotoma*, a cladistic study of all the above mentioned genera was undertaken. This paper deals with the results of this study.

Methods and materials

Taxa, characters, polarization and data matrix

Because all the genera, when combined, consist of over 300 species, only certain taxa were selected as representatives for each genus. Selected taxa and their generic synonomy are listed in Table 1. Data concerning these were obtained from the following sources: Bayer 1976; Brown 1904 and 1908; Bruyns 1985 and 1995; Bullock 1963; Dyer 1980 and 1983; Huber 1957 and 1967; Meve 1995; Ngwenya *et al.* 1995, Nicholas 1989, and Peckover 1993; as well as from the authors personal knowledge of these plants. Tables 2 and 3 list chosen characters and their polarization from plesiomorphic to apomorphic.

Outgroup selection

Two different outgroups were used:

- The first of these was *Neoschumannia* Schltr. Meve (1995) suggested that the morphology of the corona of this genus indicates that it has a position close to the base of the tribe Ceropeginae, which includes all the genera in the in-group.

- The second outgroup used was *Emplectanthus* N.E. Br. This group was chosen because a preliminary unpublished cladistic study of all the southern African genera of Asclepiadaceae (undertaken by the senior author) suggested that this genus is the sister group to *Ceropegia* and its allies and, therefore, the ideal outgroup (Figure 2).

Software

The Hennig86 cladistics program was used to analyze the data and to produce, via parsimonious analysis, a set of phylogenetic trees.

Results

Cladograms were generated from two different data sets and for different sets of taxa as follows:

- The first set of cladograms were generated for all taxa listed in Table 1, using all characters that could be polarized. This data was analyzed using the Mhennig* command which makes several passes through the data. One tree (Figure 3) was produced. Analysis was repeated using Mhennig* and Branch Swapping, which generated 130 equally parsimonious trees. In all trees the major groupings stayed the same, only the position of individual taxa in each group (especially those of *Ceropegia* and *Brachystelma*) changed places. It must be borne in mind when looking at the results from this data set that many of the characters used could be considered inappropriate and equivocal for what should be a rigorous scientific study. Such characters include degree of corolla synorganization (Figure 4).
- The cladogram produced from the above analysis (Figure 3) suggested that *Fockea* Endl. was not part of the in-group. As a result, the group was removed from the taxa list. Characters that could be considered weak, misleading or inappropriate in terms of the phylogenetic information they could supply, or that were equivocal were also removed. The core of remaining characters, for which the direction of polarization was certain (such as rootstock type; see Figure 5) were considered good. A few of these characters (such as inflorescence type; see Figure 6) although problematic were

nonetheless retained in the second analysis because their direction of polarization was unequivocal. The Mhennig* analysis was repeated first using *Neoschumannia* as the outgroup (Figure 7) and then *Emplectanthus*. The latter analysis produced two equally parsimonious trees (Figures 8 and 9). Analysis for both outgroups were repeated using Mhennig* and Branch Swapping. Analysis using *Neoschumannia* as the outgroup generated 20 equally parsimonious trees and the one using *Emplectanthus* as the outgroup generated 18 such trees. In all these trees the major groupings stayed the same, only the position of individual taxa in each group (especially those of *Ceropegia* and *Brachystelma*) were altered.

Discussion

This discussion looks at just some of the more salient and interesting features shown by the four cladograms figured.

Anisotoma, *Macropetalum*, *Neoschumannia*, and *Sisyranthus* always come up as monophyletic. *Emplectanthus* is monophyletic only in Figure 7, but paraphyletic in Figures 3, 8 and 9. However, examination of herbarium material suggests that this paraphylly is doubtfully the case in reality, and the results obtained may have been due to the outgroup used.

Riocreuxia is always placed basely, indicating that it is not as derived, and therefore not as advanced, as most of the other genera. *R. aberrans* (Figure 10) is never included with the other species of *Riocreuxia*, which are monophyletic except in Figure 7. *R. aberrans* is always shown as coming from a common ancestor with *Anisotoma*, however, although *Riocreuxia* is probably more primitive in its overall features, it is doubtfully closely related to *Anisotoma*.

Several *Ceropegia* species and *B. gymnopodum* (previously included in *Ceropegia*) are also shown to emerge from the same root as *Anisotoma* and *R. aberrans*. This is unexpected as the affinities of *Anisotoma* seem, base on the observation and dissection of herbarium specimens, to be more with *Brachystelma* than with *Ceropegia*. The fascicle-rooted ceropegias are shown as being monophyletic in Figures 7 and 8, and

as having a different origin from the tuberous species (a result not anticipated by these authors). The results given in Figures 3 and 8 show a much more complicated evolutionary history for these species, and suggest that the fascicle-rooted condition has arisen independently at least two, if not more times within the genus. As mentioned, *Ceropegia* is shown to be polyphyletic and (apart from the fascicle-rooted species which are monophyletic) *C. meyeri* (Figure 11) is consistently shown to be more closely related to *Riocreuxia* than the rest of the ceropegias. The implications of this are obscure and doubtfully so in reality. *C. antenniferai* Schltr., *C. conrathii* Schltr., *C. dinteri* Schltr., *C. filiformis* (Burch.) Schltr., *C. rudatsii* Schltr., *C. stentiae* E.A. Bruce, *C. tomentosa Schltr.*, and *C. woodii* Schltr. are also not placed with the other ceropegias, falling instead at a variety of different points on the cladograms. Given the data we supplied it with, the computer program obviously had problems placing these species with any certainty.

Like *Ceropegia*, *Brachystelma* is also indicated as being polyphyletic. *B. natalense* and *B. schizoglossoides*, are shown as being closely related to each other but not to the rest of the brachystelmas. *B. villosum* is often shown as being set apart from the other species of the genus. As already mentioned, *B. gymnopodum* seems more closely related to *Ceropegia* than to *Brachystelma*. *Brachystelma* is often shown as consisting of two main groups. One of these groups (*B. circinatum* and allies) is often shown as being more closely related to *Tenaris* and *Macropetalum* than to the other brachystelmas. The other group (*B. australe* and allies) is often placed terminally, and in Figures 3 and 8 is suggested to contain *Ceropegia mafekingensis* (previously placed in *Brachystelma*). However, in Figures 7 and 9, *C. mafekingensis* is placed with *Ceropegia*. The position of *C. mafekingensis* is thus shown to be equivocal.

Macropetalum is consistently shown as coming from a common ancestor with *Tenaris*, or as being closely related to it. In fact, *T. filiformis* is shown in three of the cladograms as being neither part of *Macropetalum* nor *Tenaris* but as being intermediate and from a common origin with both. *Brachystelma macropetalum* is placed with *Tenaris* and *Macropetalum* (Figures 7 and 8) or as being closely related to them (Figure 9). These cladograms do not support the inclusion of *Tenaris* and *Macropetalum* in *Brachystelma*.

Sisyranthus is shown as enjoying a common ancestor with *Tenaris* and *Macropetalum*, (Figures 7 and 8), or with *Riocreuxia aberrans* and *Anisotoma* (Figure 3),

or as being related (but not from a common ancestor) to *Macropetalum* and *Tenaris*. Its position must be seen as equivocal.

All analyses show that the degree of homoplasy is high, with the *Consistency Index* varying from 17 to 19 and the *Retention Index* varying from 55 to 58. A good example of a common homoplasious character is corolla lobe tip connation which seems to have occurred independently in at least three of the genera included in this study, viz. *Brachystelma*, *Ceropegia* and *Riocreuxia* (Figure 12). Such convergent evolution in the corolla, corona and gynostegium of asclepiad flowers is common, and probably due to similar pollinator and pollination demands.

Conclusion

Although the results of this study are preliminary, they do, however, give some insight into the evolution of the groups concerned, as well as the evolution of some of their characters. Good synapomorphies have been found for some of the groups; even for those groups that are unfortunately ambiguous. This study tends to indicate that the fascicle-rooted brachystelmas are probably not monophyletic. *B. natalense* and *B. schizoglossoides* are clearly related and set apart from the other brachystelmas, but do not originate from a common ancestor with *Anisotoma*; as was postulated. However the cladograms are not unequivocal even on this point. Unfortunately, many of the cladograms are clearly in conflict with taxonomic and phylogenetic patterns suggested by the overall gestalt of the species themselves. In this connection, the cladogram constructed from all available data (no matter how weak!) seem to echo the groupings established by more classical taxonomic methods.

It is hoped that the results presented here will foster, or direct, further research into these fascinating, closely related genera. In the end, however, because of the commercial importance of both genera, and the fact that widespread habitat destruction in southern Africa threatens many of their species with extinction, we need a definitive unequivocal classification (based on phylogeny) for *Brachystelma* and *Ceropegia*. Any information regarding these genera is thus important to the horticultural industry and to

conservationists planning effective management strategies for these dwindling plant resources. For this reason, researchers working on these important and complex genera (in which traditional morphological characters have been unable to bring resolution and consensus) should be encouraged to utilize more modern, high powered techniques such as DNA profiles, secondary metabolite analysis, cladistics, etc.

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Figure Captions

Figure 1: a. *Brachystelma australe* R.A. Dyer (stem tuber), b. *Brachystelma franksiae* N.E. Br. (fascicled fleshy roots), c. *Brachystelma natalense* (Schltr.) N.E. Br. (fascicled fleshy roots), d. *Sisyranthus trichostomus* K. Schum. (fascicle-roots), e. *Ceropegia ampliata* E. Mey.(fibrous to some what fleshy & fascicled), and f. *Riocreuxia picta* Schltr. (fascicled fleshy roots) (Photographs a, b and d A. Nicholas; c Y. Singh; e D. Hardy; and f J. Vahmëyer.).

Figure 2: Cladogram of the Asclepiadaceae (including Periplocaceae) in southern Africa. From a preliminary unpublished cladistics study undertaken by the senior author.

Figure 3: Cladogram produced using all taxa and all characters, and analyzed using the Mhennig* command.

Figure 4: The degree of corolla synorganization is an example of an inappropriate and equivocal character. a. *Brachystelma franksiae* 0% synorganized (From Medley Wood, Natal Plants, 6: t. 588); b. *Brachystelma blepharanthera* 15% synorganized (From Dyer 1983); c. *Riocreuxia burchellii* 60% synorganized (From Fl. Pl. Afr. t. 1124, artist R. Holcroft); d. *Brachystelma oianthum* 90% synorganized (From Fl. Pl. Afr. 537, artist R. Holcroft).

Figure 5: Rootstock type is an example of a character in which the direction of polarization is well supported. a. *Riocreuxia aberrans* with fibrous root (From Fl. Pl. Afr. t. 1253, artist C. Letty); b. *Ceropegia rudatisii* with fascicle-roots (From Dyer 1983, artist R. Holcroft); and c. *Ceropegia conrathii* with stem tuber (From Flora S. Afr. 27, 4: 1979, artist R. Holcroft).

Figure 6: Inflorescence type is an example of a problematic character in that polarization, following evolution, takes two different directions. a. *Riocreuxia burchellii* with lax bostrycoid cyme (From Fl. Pl. Afr. t. 1124, artist R. Holcroft); b. *Ceropegia multiflora* with condensed bostrycoid cyme; c. *Ceropegia sandersonii* with flowers solitary (From Dyer 1983, artist R. Holcroft); and *Ceropegia mafekingensis* with umbelliform inflorescence (From Dyer 1983, artist R. Holcroft).

Figure 7: Cladogram using selected characters only with *Neoschumannia* as the outgroup, and analyzed using Mhennig*. Only one parsimonious tree was produced.

Figure 8: Cladogram using selected characters only with *Emplectanthus* as the outgroup, and analyzed using Mhennig*. This is the first of two most parsimonious trees produced.

Figure 9: Cladogram using selected characters only with *Emplectanthus* as the outgroup, and analyzed using Mhennig*. This is the second of two most parsimonious trees produced.

Figure 10: *Riocreuxia aberrans* is consistently shown as coming from a common ancestor with *Anisotoma* rather than the rest of the genus *Riocreuxia*. This result does not accord with data supplied by the examination and dissection of herbarium material. a. Part of flowering stem X 0,5; b. Longitudinal section of flower exposing corona (outer corona forming margin to pockets, inner lobes over topping the staminal column) X 3.5; c. Pollinarium (note pollinia with shortly pellucid terminal beak and its attachment at its base to the caudicles) X 20. (From Fl. Pl. Afr. t. 1253, artist C. Letty).

Figure 11: *Ceropegia meyeri* is not placed with the other members of the genus *Ceropegia*. In all cladograms this species is placed basely near the genus *Riocreuxia* with which its does share some common characteristics, such as the unusual constrictions between the seeds in the follicle. a. Part of flowering stem X 0,5; b. Calyx X 1.5; c. Corona X 5; d. Follicle X 0.5. (From Fl. Pl. Afr. t. 30, artist R. Holcroft).

Figure 12: An example of a common homoplasious character is corolla lobe tip connation, this is an evolutionary trend which has occurred independently in at least three of the genera included in this study: viz. a. *Brachystelma circinatum* (From Fl. Pl. Afr. t. 536, artist R. Holcroft); b. *Brachystelma montanum* (From Dyer 1983, artist R. Holcroft); c. *Ceropegia mafekingensis* (From Dyer 1983), d. *Ceropegia nilotica* (From Fl, Pl. Afr. t. 1113, artist C. Letty); e *Riocreuxia aberrans* (From Fl. Pl. Afr. t. 1253, artist C. Letty); f. *Riocreuxia picta* (From Fl. Pl. Afr. t. 1124, artist R. Holcroft).

Table 1: List of taxa used in this study, with generic synonomy and rootstock type

SPECIES	GENERIC SYNONOMY	ROOTSTOCK TYPE
Neoschumannia kamerunensis		Fibrous?
N. cardinea	*Swynnertonia*	Fibrous?
Emplectanthus cordatus		Fibrous?
E. gerrardii		Fibrous?
Ceropegia ampliata		Fascicled
C. antennifera		Tuber
C. bowkeri		Fascicled
C. carnosa		Fascicled
C. conrathii		Tuber
C. dinteri		Tuber
C. dissincta		Fascicled
C. filiformis	*Systrepha*	Fascicled
C. mafekingensis	*Brachystelma*	Tuber
C. meyeri		Tuber
C. rudatzii		Fascicled
C. sandersonii		Fascicled
C. stentae		Tuber
C. tomentosa		Fascicled
C. woodii		Tuber
Riocreuxia aberrans	*Ceropegia*	Fascicled
R. flanaganii	*Ceropegia*	Fascicled
R. picta	*Ceropegia*	Fascicled
R. torulosa	*Ceropegia*	Fascicled
Brachystelma australe		Tuber
B. caffrum	*Tapeinostelma*	Tuber
B. canum		Fascicled
B. circinatum	*Dichaelia*	Tuber
B. compitum		Fascicled
B. frankiae		Fascicled
B. gerrardii	*Dichaelia & Brachystelmaria*	Fascicled
B. gracile		Tuber
B. gracillimum	*Dichaelia*	Tuber
B. gymnopodum	*Ceropegia*	Tuber
B. huttonii	*Decaceras*	Tuber
B. longifolium	*Brachystelmaria & Lasiostelma*	Fascicled
B. macropetalum	*Brachystelmaria & Lasiostelma*	Fascicled
B. minimum		Tuber
B. nanum	*Lasiostelma*	Tuber
B. natalense	*Aulostephanus*	Fascicled
B. oianthum		Tuber
B. pulchellum	*Micraster*	Tuber
B. ramosissimum	*Brachystelmaria & Lasiostelma*	Fascicled
B. sandersonii	*Dichaelia, Brachystelmaria & Lasiostelma*	Fascicled
B. schinzii	*Craterostemma*	Tuber
B. schizoglossoides	*Sisyranthus*	Fascicled
B. stenophyllum	*Siphonostelma*	Tuber
B. tabularium		Tuber
B. tuberosum		Tuber
B. villosum	*Dichaelia*	Tuber
Anisotoma cordifolia	*Anisotomaria & Lophostephus*	Semi-fascicled
A. pestunculata		Semi-fascicled
Macropetalum burchellii		Tuber
Tenaris chloranthe	*Macropetalum*	Tuber
T. filifolia	*Macropetalum*	Tuber
T. rubella		Tuber
T. simulans		Tuber
Sisyranthus compactus	*Lagarinthus*	Fascicled
S. fanniae		Fascicled
S. imberbis		Fascicled
S. randii		Fascicled
S. trichostomus		Fascicled
S. virgatus		Fascicled
Fockea angustifolia	*Brachystelma*	± Tuberous
F. crispa		± Tuberous
F. multiflora		± Tuberous

TABLE 2: Characters and their polarization

*	N°	Character	State 0	State 1	State 2	State 3	State 4	State 5	State 6	State 7
	1	Habit	Woody climber	Woody twinner	Herbaceous twinner	Herb				
	2	Rootstock type	Fibrous & fusiform	String of fusiform	Cluster of fusiform	Tuber				
*	3	Rootstock succulence	Fibrous	Fusiform	Succulent fusiform	Tuber				
*	4	Rootstock woodiness	Fibrous	Tuber or fusiform	Woody					
	5	Stem number	3 to 8	8 to many or 1 to 3	1 only or many only					
	6	Stem height	More than a 1000 mm	1000 to 400 mm	399 to 200 mm	199 to 150 mm	149 to 100 mm	90 to 50 mm	59 to 1 mm	
	7	Stem orientation	Erect	Spreading	Procumbent	Prostrate				
	8	Stem protraction	Twining erect	Spreading, twining to rambling	Procumbent prostrate or erect herb					
	9	Leaf width	90 to 60 mm	59 to 31 mm	30 to 21 mm	20 to 11 mm	10 to 7 mm	6 to 4 mm	3 to 1 mm	
*	10	Petiole length	Long (25 to 5 mm)	Short to very short (5 to 1 mm)	Subsessile (1 to 0 mm)	Sessile				
*	11	Leaf vestiture	Glabrous	Hairy	Villous					
	12	Flower number	3 to 15	Many or 2 or 1						
	13	Inflorescence position	Axillary at nodes	Lateral at nodes	Subterminal	Terminal				
	14	Inflorescence type	Bostrychoid Panicle or Cyme	Raceme or solitary	Fascicled	Umbelliform				
*	15	Flower orientation	Erect	Nodding	Pendulous					
*	16	Corolla length	15 to 20 mm	21 to 30 mm	31 to 50 mm	51 to 100 mm				
*	17	Corolla shape	Reflexed	Cupular or rotate	Campanulate	Urceolate or tubular	Beaked			
*	18	Corolla synorganization	None	1 to 5%	6 to 10%	11 to 29%	30 to 49%	50 to 69%	70 to 89%	90 to 100%
	19	Corolla tube shape	None	Shallow campanulate or cupulate	Tubular	Globose				
*	20	Corolla hair	Present	Glabrous or velutinous						
	21	Papillae present	No	yes						
	22	Vibratile hairs present	Yes	No						

Table 2: Cont.

*	N°	Character	State 0	State 1	State 2	State 3	State 4	State 5	State 6	State 7
	23	Inner corona fused to outer	No	At base	Yes	Pseudo-uniseriate				
*	24	Outer corona with pockets	No	Yes						
	25	Inner corona shape	Spathulate or ligulate	Triangular deltoid teeth or lanceolate linear	Bumps or ridges or filiform					
	26	Inner Corona apex type	Monofid	Monofid or bifid	Bifid					
	27	Hairs on the inner Corona	Yes	No						
	28	Inner corona orientation	Erect	Slightly incumbent	Incumbent					
	29	Habitat	Forest	Other						
*	30	Distribution	Tropical Africa	Central Africa or widespread	Localized					
*	31	Maximum pedicel length	50 to 21 mm	20 to 10 mm	9 to 5 mm	4 to 3 mm	2 to 0 mm			
*	32	Maximum corolla lenght	10 to 20 mm	21 to 40 mm or19 to 10 mm	41 to 60 mm or 9 to 3 mm	2 to 1 mm				
	33	Corolla tube constricted at mouth	No	Yes						
	34	Corolla markings	spotted	Stripped or smooth						
	35	Outer corona	Bifid or bilobed	Notched	None					
	36	Outer corona tooth trends	Bifid, bilobulate or notched	Trifid or none						
	37	Corolla lobes revolute	Yes	No						
	38	Outer corona teeth number	5	0 or 10	15 + 5 or 15					
	39	Outer teeth taller than gynostegium	Same or just	Shorter or taller						
*	40	Outer corona hairy	Yes	No						
*	41	Underground stem present	No	Yes						
	42	Leaves revolute	No	Inflexed or reflexed						
*	43	Internodes over 60 mm long	Yes	No						

Table 2: Cont.

*	N°	Character	State 0	State 1	State 2	State 3	State 4	State 5	State 6	State 7
	45	Corolla cylindrical in bud	No	Yes						
	46	Corolla lobe tips inflexed	No	Yes						
	47	Corolla lobes linear	No	Yes	Filiform					
	48	Outer corona in relation to inner	Shorter	Same	Taller					
	49	Corolla replicate	No	Yes						
	50	Lobe tips forming a cage	No	Yes						
	51	Stems branched above	Yes	Once or twice	No					
	52	Outer corona cupular	No	Yes	Annular					
	53	Leaves cordate	No	Yes						
*	54	Pedicel elongating after fertilization	No	Yes						
*	55	Corona arising above base of staminal column	Yes	No						
*	56	Stems winged	No	Yes						
*	57	Corolla lobes thickened in middle	No	Yes						
	58	Corona exposed	Yes	Just	No					
	59	Corolla tube with basal inflation	No	Yes						
*	60	Rooting from the nodes	No	Yes						
*	61	Stems succulent	Woody	Herbaceous	Succulent					
	62	Leaves rudimentary	No	Yes						
	63	Leaves deciduous	No	Yes						
	64	Corolla tube curved	No	Yes						
	65	Leaves fleshy	Herbaceous	Semi-fleshy	Fleshy					
*	66	Maximum peduncle length	120 to 50 mm	49 to 20 mm	19 to 10 mm	9 to 1 mm	Sessile			
	67	Peduncle length	Long	Subsessile	Sessile					
	68	Corolla lobe canopy present	No	Yes						

Table 2: Cont.

*	Nº	Character	State 0	State 1	State 2	State 3	State 4	State 5	State 6	State 7
	69	Appendage beyond corolla cage	No	Yes						
*	70	Mixture of vibratile hairs & cilia on corolla lobes	No	Yes						
	71	Corolla lobes dilated at tip	No	Slightly	Yes					
	72	Follicles constricted between seeds	No	Yes						
*	73	Outer Corona with extra teeth	No	Yes						
	74	Leaves heart-shaped	Yes	No						
*	75	Stems ±woody	Yes	No						
	76	Corona whorl number	3 whorls	2 whorls	pseudomonoseriate					
	77	3rd whorl reflexed	Yes	No						
	78	3rd whorl ovate in shape	Yes	No	Tubular	Absent				
	79	Staminal skirt present	Yes	No						
	80	Anther appendages with hairs	No	No & yes	Yes					
	81	Membranous anther appendages	None	Fleshy & short	Large					
*	82	Style exceeding anther cells	No	Yes						
	83	Anther appendage present	No	Yes						

* Characters omitted from the second analysis

TABLE 3: Characters and their polarization

Taxa	Character Polarization
Neoschumannia kamerunensis	07??? 10000 00100 00000 00000 00000 00000 00100 00000 10000 00000 00000 00000 00000 00000 00000 000
N. cardinea	07??? 10000 00100 00000 00100 20000 00000 00000 00000 00000 00000 00000 00000 00000 00000 00100 000
Emplectanthus cordatus	27?12 00010 10117 21410 01111 01001 42110 01111 00?00 00000 00111 00200 10000 00000 01011 11310 000
E. gerrardii	27?12 00010 10117 11311 01110 01102 12110 01111 00?00 00000 00171 00200 10000 33000 01011 11310 000
*Ceropegia bowkeri**	32211 60262 01210 23520 01111 01012 11100 01110 00100 00000 21000 00210 10000 42000 00001 11310 000
*C. tomentosa**	32212 20262 01110 23520 01111 01012 11000 01170 07001 01710 21001 00210 10000 42000 00001 11310 000
*C. ampliata**	21212 01162 00110 33620 01202 01010 10010 01100 00000 00011 10000 00211 21111 42000 00001 11310 000
*C. filiformis**	22212 11141 00110 33621 01111 01012 10010 01101 00010 01011 10001 00210 10010 20000 00001 11310 000
*C. rudatsii**	32212 20231 01110 33620 01202 01012 01010 01170 00001 01010 10000 00210 10000 42000 00001 11310 000
*C. sandersonii**	22212 00020 00100 33620 01202 01012 11012 11110 00100 00011 21101 00210 20002 20110 00001 11310 000
*C. distincta**	20002 00010 01110 23620 01100 01012 11000 01100 00100 00011 21000 00210 20011 10110 00001 11310 000
*C. carnosa**	23312 00030 10110 03620 01102 01012 12010 01100 00000 00011 20001 00210 10011 ??000 00001 11310 000
C. mafekingensis	33312 60241 11130 13520 11211 00011 22100 01170 01110 10010 21007 01200 10000 42000 00001 11310 000
C. dinteri	33312 20253 01010 33520 00101 01071 02010 01171 01100 01?00 20001 00210 10000 42001 00001 11310 000
C. antennifera	33312 20262 01110 33520 01111 01012 02012 11170 01100 01000 21007 00210 10000 42000 20001 11310 000
C. stentiae	33311 40262 01110 33520 01111 01071 11010 11201 11100 02001 00001 00210 10010 42000 00001 11310 000
C. conrathii	33311 10232 10110 23620 11310 01011 11010 01001 01110 01001 00001 00210 10010 42000 00001 21310 000
C. woodii	23311 13230 01100 13620 01311 01011 12000 01001 00100 00011 00101 00211 10001 20000 20001 21310 000
C. meyeri	23312 00020 10100 33620 01201 01002 11100 01001 00010 01011 00101 00210 10000 42000 00011 11310 000
Brachystelma oianthum	31311 50231 11111 13730 10211 01011 42002 10101 00100 00010 20001 00200 10000 42000 00001 11310 000
B. tuberosum	31311 40231 10110 02511 00211 00072 22002 11111 00100 00010 20001 00200 10000 42000 00001 11310 000
B. australe	31311 11241 01111 02410 01211 01012 11012 11101 00100 00010 20001 00100 10000 42000 00001 11310 000
B. pulchellum	30310 23261 11110 21311 01211 01012 22011 01101 00100 00010 20001 00100 10000 42000 00001 11310 000
B. caffrum	31311 42241 11110 21311 01201 01012 02012 11111 00100 00010 20001 00100 10000 42000 00001 11310 000
B. nanum	30310 50241 10110 32311 01201 01011 14010 01110 10100 00210 20001 00100 10000 42000 00001 11310 000
B. huttonii	33312 40262 10210 31201 01201 01012 12010 00111 01100 00210 20001 00000 10000 42000 00001 11310 000
B. tabularium	33311 20251 10110 11101 01000 01012 41010 01101 00011 11110 20001 00000 10000 42000 00001 11310 000
B. minimum	33311 50261 01111 30401 01202 01012 13012 11111 00100 00200 21001 00000 10000 42000 00001 11310 000
B. schinzii	33311 30261 11110 11301 00202 01011 12012 11111 01100 00210 22001 00000 10000 42000 00001 11310 000
B. villosum	33311 20241 20110 03210 01201 01011 21010 01171 00101 01701 20001 00200 10000 42000 00001 11310 000
B. gracile	33311 10252 10012 23000 01100 01011 11010 01111 01001 01011 20001 00000 10000 42000 00001 11310 000
B. gracillium	33311 10241 11110 24001 01100 01011 42010 01110 00111 01001 00001 00200 10000 42000 00001 11310 000
B. circinatum	33311 20241 11112 13000 01100 01211 31010 01100 01111 01101 00001 00000 10000 42000 00001 11310 000
B. stenophyllum	33312 30252 00110 03410 01101 01211 21111 11171 01100 01201 01001 00200 10000 42000 00001 11310 000

TABLE 3: Cont. *

Taxa	Character Polarization
B. gymnopodum	33311 40221 10102 23720 01201 01211 12010 01010 00100 00210 11001 00210 10010 30000 00001 11310 000
*B. natalense**	32212 10212 10110 31411 01111 01212 02010 01111 00100 00010 20010 00100 10000 42000 00001 11310 000
*B. comptum**	32112 30241 11110 11000 00111 00212 11112 11110 00100 00200 10070 11200 10000 42000 00001 11310 000
*B. gerrardii**	32112 20231 21110 00001 10200 01011 00110 00101 00110 00010 10000 00200 10000 42000 00001 11310 000
*B. macropetalum**	32112 10261 11111 21111 01200 00011 01000 01111 00101 01000 10000 00100 10000 42000 00001 11310 000
*B. canum**	32112 ?0242 11117 17271 01212 01211 71012 11111 01110 01210 20?00 00000 10000 42000 00001 11310 000
*B. schizoglossoides**	32212 20253 00110 32411 01101 01112 33010 01110 00100 10100 20000 00000 10000 31000 00001 11310 000
*B. ramosissimum**	32211 30252 00110 31101 11111 01211 22011 01170 00110 00210 01000 10000 10000 42000 00001 11310 000
*B. sandersonii**	32211 10232 10120 31001 11101 01212 22010 00100 00100 00100 10000 01100 10000 42000 00001 11310 000
*B. franksiae**	32211 20242 10111 21111 11101 01012 12010 01100 00100 00000 00001 00200 10000 42000 00001 11310 000
*B. longifolium**	32211 20252 11110 11001 11101 01011 21010 01170 01100 01010 00000 00200 10000 42000 00001 11310 000
Riocreuxia picta	22122 00000 10100 13621 01202 01702 01011 01001 00000 02201 00101 00210 10000 00000 01011 11310 101
R. torulosa	22122 00000 10100 13621 01202 01202 01110 01101 00000 01211 00100 00210 10000 00000 01111 11310 101
R. flanaganii	21121 00010 10131 03521 01201 01012 22110 01111 00000 02011 00101 00210 10000 20000 01011 11310 101
R. aberrans	32120 10210 10112 02411 01311 01011 01010 01001 00100 00010 00101 00200 10000 ?7000 01011 21310 101
Anisotoma cordifolia	22210 13220 10137 21410 01302 01012 02010 01110 00100 00000 00101 00200 10000 10000 00001 21312 001
A. pedunculatum	22210 13210 10137 21410 01300 20012 02010 01010 00100 00010 00101 00200 10000 00000 00001 21312 001
Macropetalum burchellii	33312 10262 00112 10111 01301 01011 21012 10111 00000 02000 10011 00000 10000 42000 10001 21310 201
Tenaris rubella	33312 10262 01212 02311 11101 01212 11011 01011 00000 01010 10000 00200 10000 10000 20001 11310 101
T. simulans	33312 10262 00332 11311 11101 01211 22010 01111 00100 01010 20000 00200 10000 10000 20001 11310 101
T. chlorantha	33312 10262 00212 21311 11101 01211 12011 01011 00100 01010 10001 00200 10000 30000 00001 11310 000
T. filifolia	33312 10262 01112 11311 01112 01011 22012 11111 00100 02000 10001 00200 10000 42000 00001 11310 000
Sisyranthus virgatum	32212 10263 10211 23530 01301 01212 03110 01271 00100 00000 20001 00200 10000 ?7000 00001 21312 001
S. compactum	32212 10263 11230 22530 01301 00012 13110 01200 00100 00000 20001 00200 10000 10000 00001 21312 001
S. faninia	31212 10262 10111 32510 01301 01112 13012 11111 01100 00000 20000 00200 10000 10000 00101 21311 001
S. trichostomus	32212 10262 11330 22531 01301 01012 13110 01211 01000 00000 20001 00200 10000 42000 00001 21312 001
S. imberbis	31212 10262 10112 22410 01302 01012 12112 11111 01100 00000 20001 00200 10000 10000 00001 21310 000
S. randii	32211 10262 10132 22531 01301 01011 12110 01111 01100 00000 00001 00200 10000 00000 00001 21312 001
Fockea multiflora	13312 00061 10000 01221 01201 01011 13010 11211 00100 00010 00007 00000 11100 10000 00000 01210 201
F. crispa	13311 10031 10110 11321 01201 01012 32010 11211 00110 01010 00000 00000 10000 42000 00000 01210 211
F. angustifolia	13310 10041 10110 01221 01202 01011 40010 11211 00110 01010 00000 00000 10000 42000 00000 01210 211

* Fascicle rooted brachystelmas and ceropegias

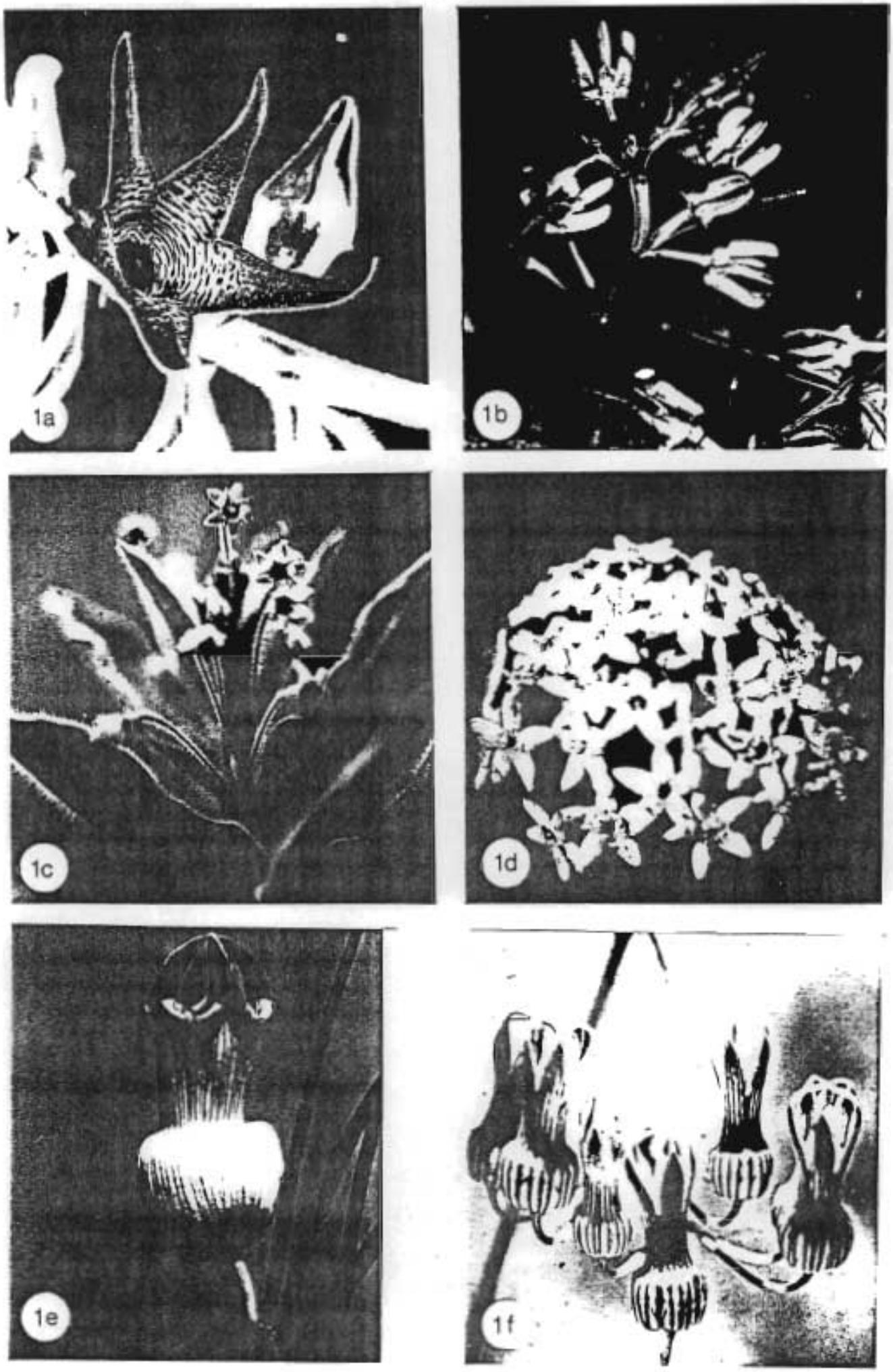

Figure 1

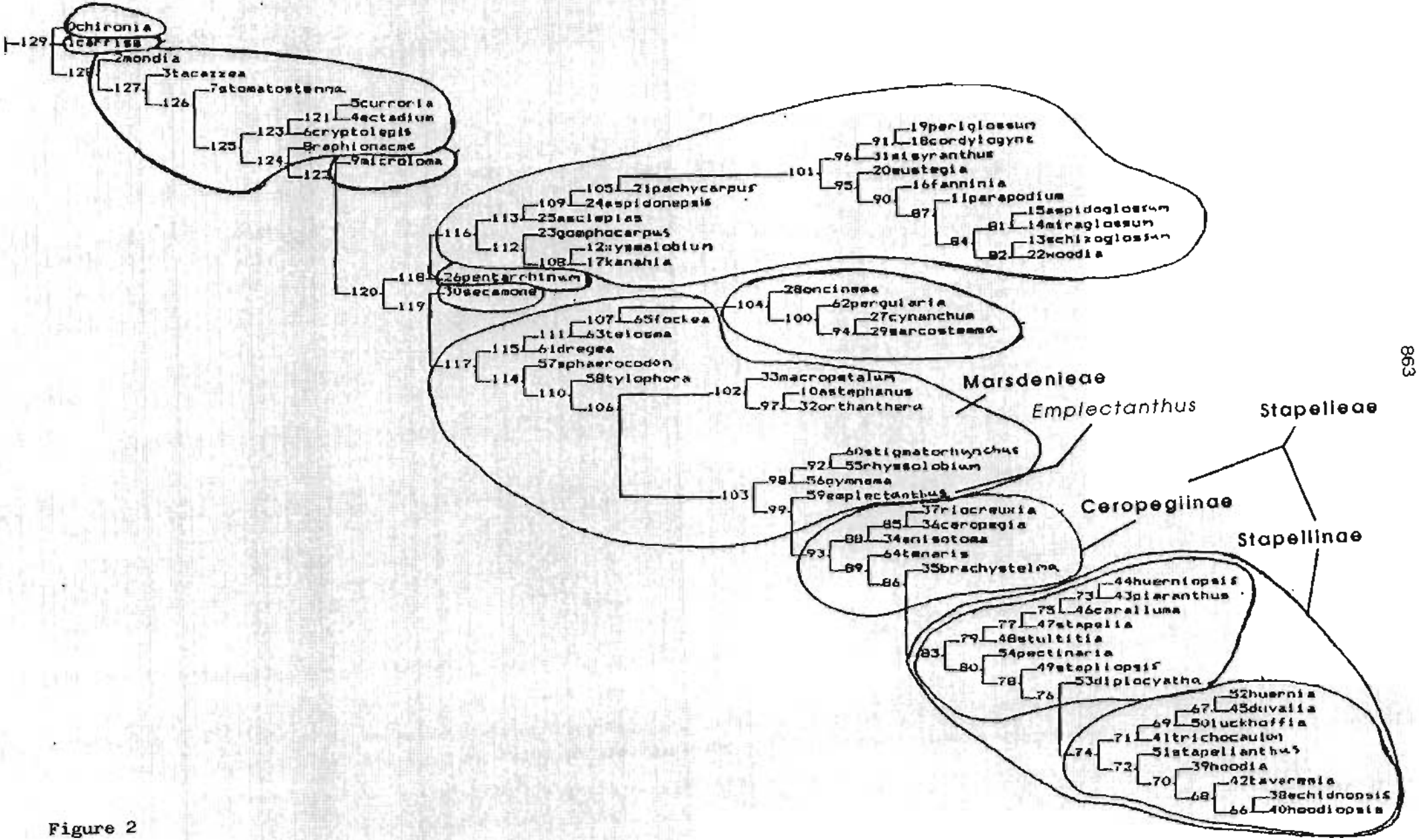
Ochronia
Acerbia
Amondia
Atacazzea
Stomatostemma
Scurrotia
Ectadium
Cryptolepis
Brephionacme
Malcolmia
Pachycarpus
Aspidonepis
Asclepias
Gomphocarpus
Xysmalobium
Kanahia
Pentarrhinum
Secamone
Periglossum
Cordylogyne
Isisyranthus
Mustegia
Fanninia
Parapodium
Aspidoglossum
Miraglossum
Schizoglossum
Woodia
Oncinema
Perquiaria
Cynanchum
Sarcostemma
Flockea
Telosma
Idregea
Sphaerocodon
Tylophora
Macropetalum
Astephanus
Orthanthera
Marsdenieae
Emplectanthus
Stapelieae
Stigmatorhynchus
Rhyssolobium
Gymnema
Asplectanthus
Ceropegiinae
Triocreuxia
Ceropegia
Enisotoma
Tenaris
Brachystelma
Stapelliinae
Huerniopsis
Piaranthus
Caralluma
Stapelia
Stultitia
Pectinaria
Stapliopsis
Diplocyatha
Huernia
Duvalia
Luckhoffia
Trichocaulon
Stapelianthus
Hoodia
Tavernaria
Echidnopsis
Hoodiopsis

Figure 2

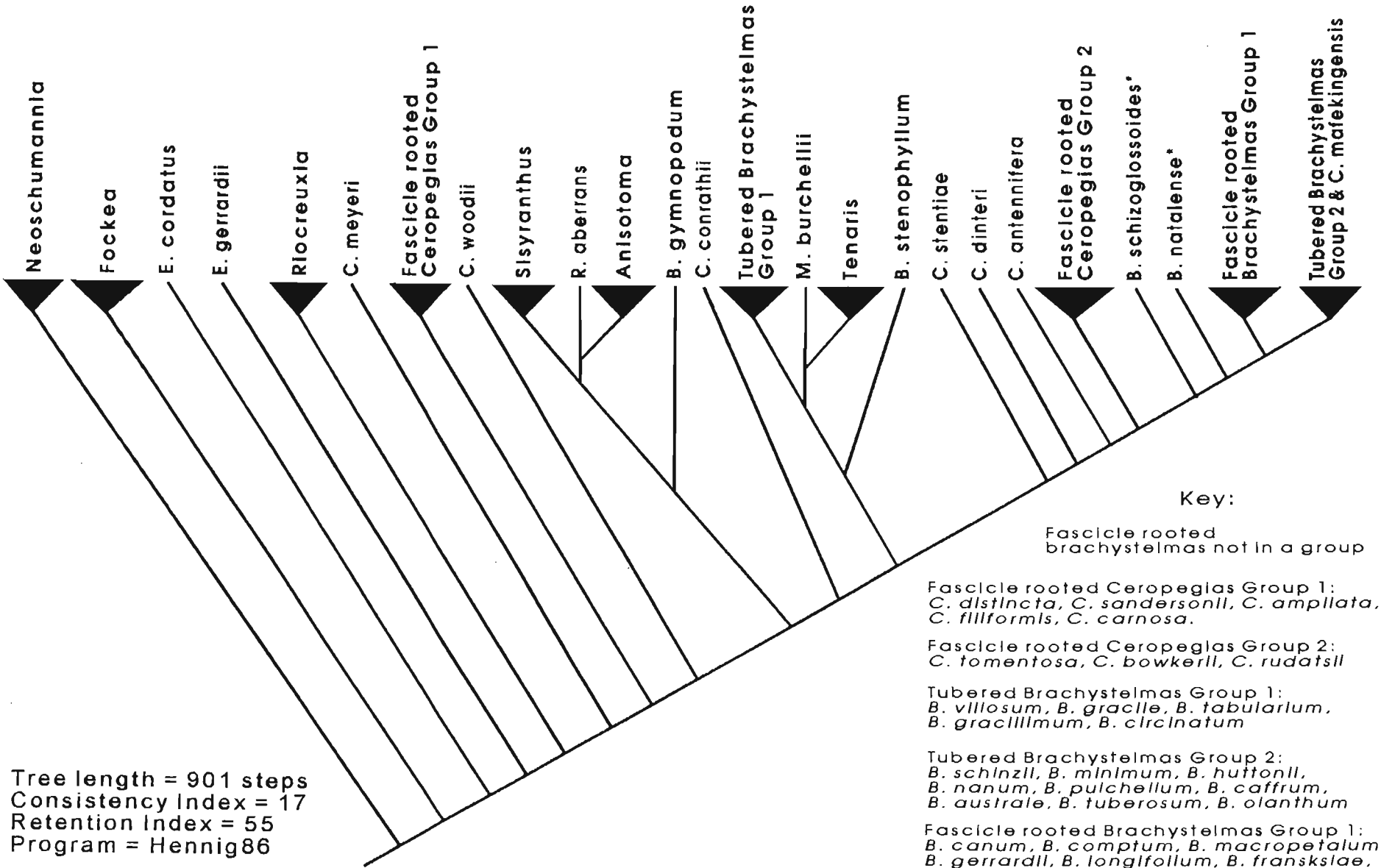
Neoschumannia
Fockea
E. cordatus
E. gerrardii
Riocreuxia
C. meyeri
Fascicle rooted Ceropegias Group 1
C. woodii
Sisyranthus
R. aberrans
Anisotoma
B. gymnopodum
C. conrathii
Tubered Brachystelmas Group 1
M. burchellii
Tenaris
B. stenophyllum
C. stentiae
C. dinteri
C. antennifera
Fascicle rooted Ceropegias Group 2
B. schizoglossoides*
B. natalense*
Fascicle rooted Brachystelmas Group 1
Tubered Brachystelmas Group 2 & C. mafekingensis
Key:
Fascicle rooted brachystelmas not in a group
Fascicle rooted Ceropegias Group 1:
C. distincta, C. sandersonii, C. ampliata, C. filiformis, C. carnosa.
Fascicle rooted Ceropegias Group 2:
C. tomentosa, C. bowkerii, C. rudatsii
Tubered Brachystelmas Group 1:
B. villosum, B. gracile, B. tabularium, B. gracilimum, B. circinatum
Tubered Brachystelmas Group 2:
B. schinzii, B. minimum, B. huttonii, B. nanum, B. pulchellum, B. caffrum, B. australe, B. tuberosum, B. olanthum
Fascicle rooted Brachystelmas Group 1:
B. canum, B. comptum, B. macropetalum, B. gerrardii, B. longifolium, B. franskiae, B. ramossissimum, B. sandersonii
Tree length = 901 steps
Consistency Index = 17
Retention Index = 55
Program = Hennig86

Figure 3

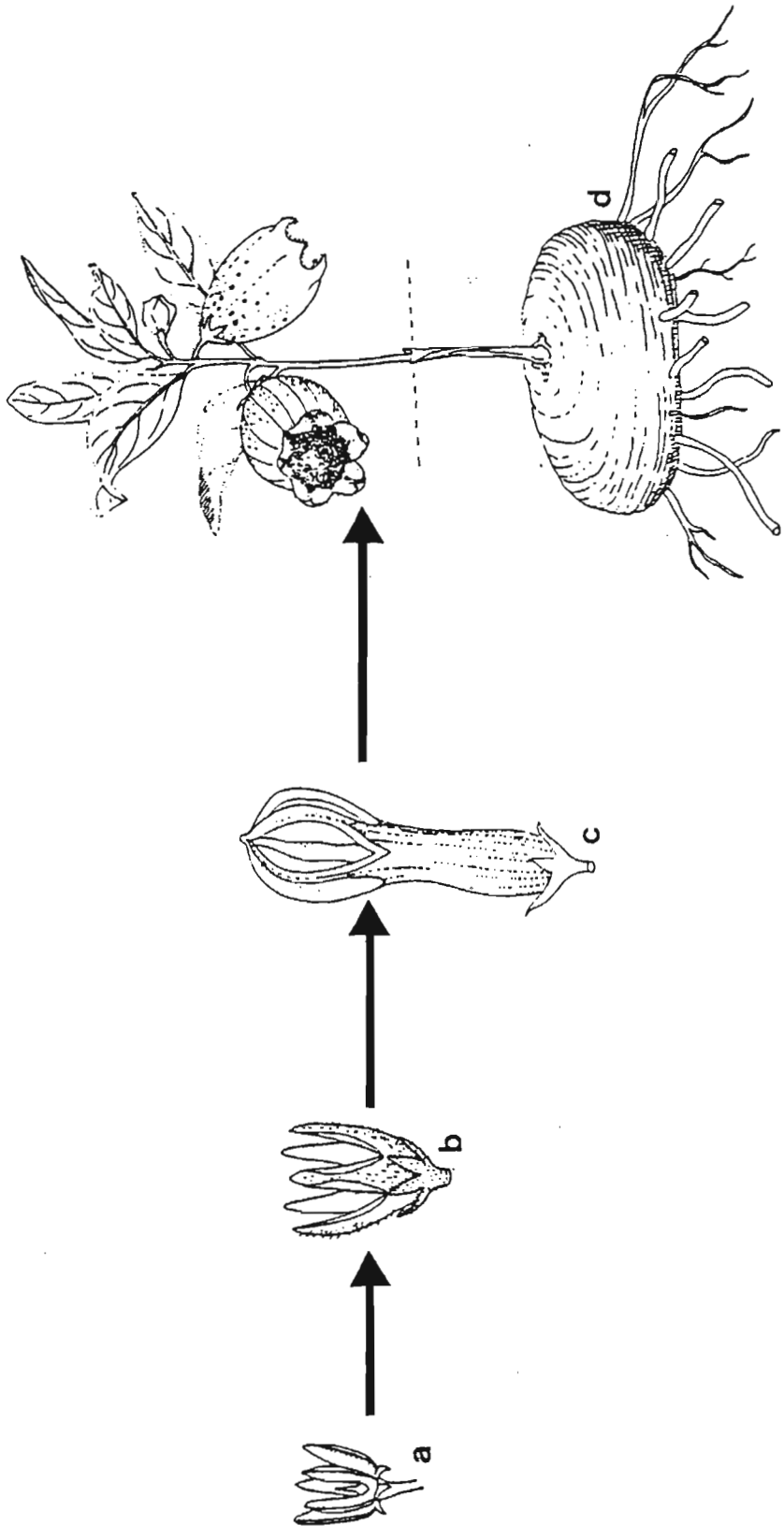

Figure 4

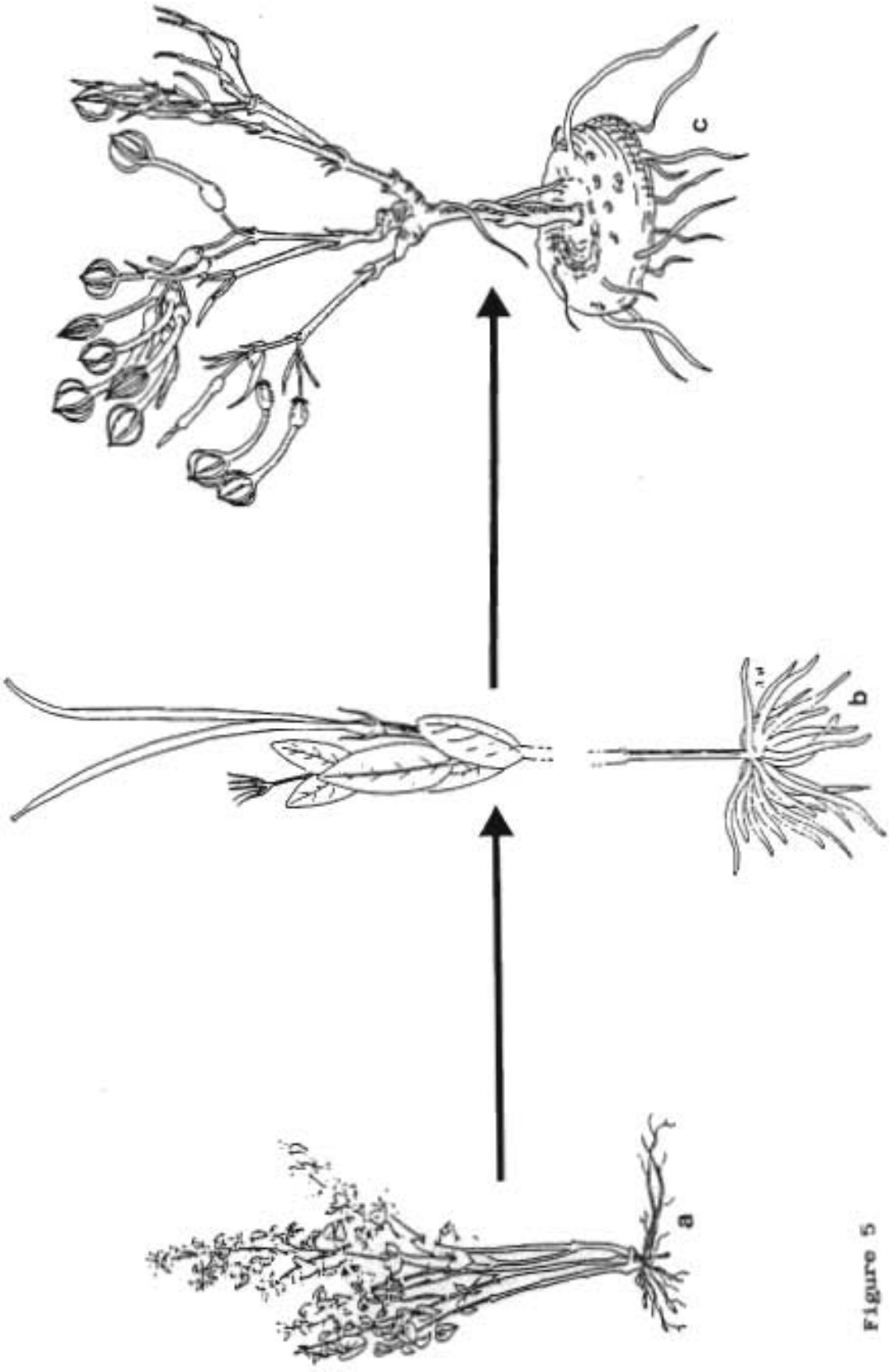

Figure 5

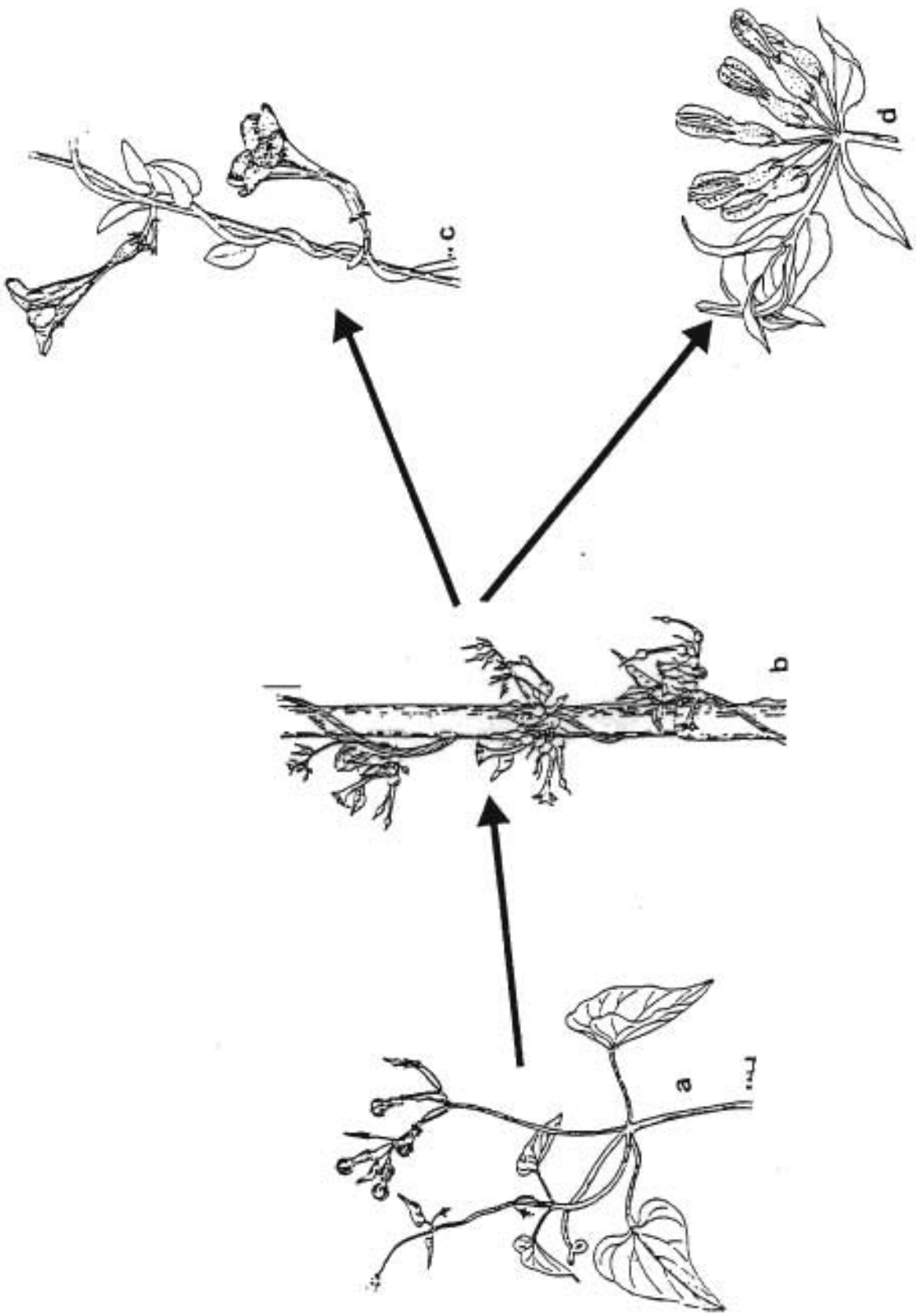

Figure 6

TREE 1
Tree length = 551 steps
Consistency Index = 19
Retention Index = 58
Program = Hennig86
E. cordatus
E. gerrardii
Neoschumannia
Riocreuxia
C. meyeri
Fascicle rooted Ceropegias
C. filiformis+
Anisotoma
R. aberrans
C. woodii
C. conrathii
B. gymnopodum
C. rudatsii+
C. tomentosus
Brachystelma (Tubered) & C. mafekingensis
B. schizoglossoides*
B. natalensis*
Sisyranthus
M. burchellii
T. filifolia
Tenaris
B. macroptalum*
B. villosum
Brachystelma (Tubered & Fascicle rooted)
Key:
+ Fascicle rooted Ceropegias
* Fascicle rooted Brachystelmas

Figure 7

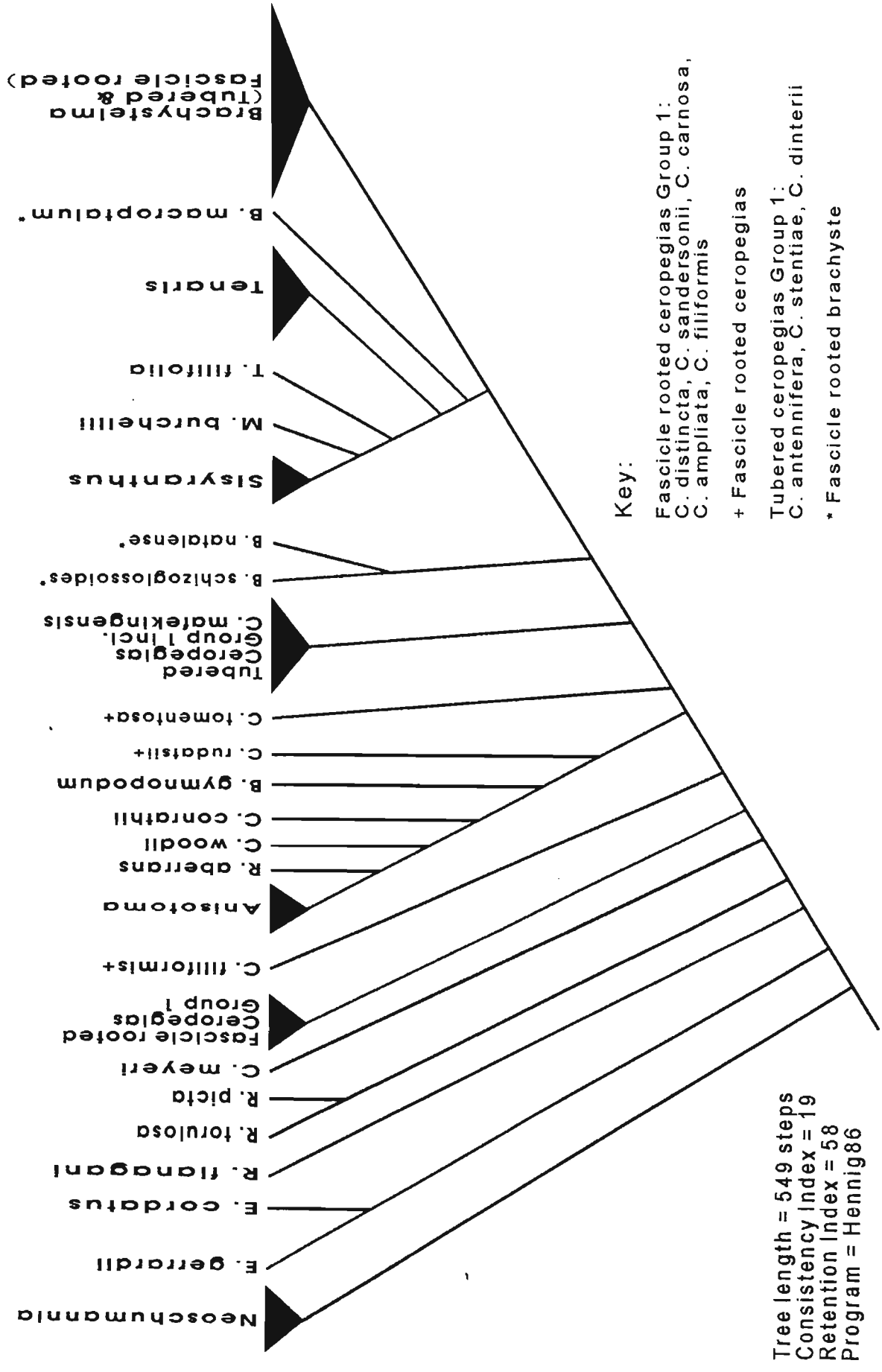
Neoschumanniа
E. gerrardii
E. cordatus
R. tianaganі
R. torulosa
R. picta
C. meyeri
Fascicle rooted Ceropegias Group 1
C. filiformis+
Anisotoma
R. aberrans
C. woodii
C. conrathii
B. gymnopodum
C. ruddsii+
C. tomentosa+
Tubered Ceropegias Group 1 incl. C. matekiηgensis
B. schizoglossoides*
B. natalense*
Sisyranthus
M. burchellii
T. filifolia
Tenaris
B. macroptalum*
Brachystelma (Tubered & Fascicle rooted)
Key:
Fascicle rooted ceropegias Group 1: C. distincta, C. sandersonii, C. carnosa, C. ampliata, C. filiformis
+ Fascicle rooted ceropegias
Tubered ceropegias Group 1: C. antennifera, C. stentiae, C. dinterii
* Fascicle rooted brachyste
Tree length = 549 steps
Consistency Index = 19
Retention Index = 58
Program = Hennig86

Figure 8

TREE 2
Tree length = 551 steps
Consistency Index = 19
Retention Index = 58
Program = Hennig86
E. cordatus
E. gerrardii
Neoschumannia
Riocreuxia
C. meyeri
Fascicled Ceropegia
C. filiformis+
Anisotoma
R. aberrans
C. woodii
C. conrathii
B. gymnopoda
C. rudatsii+
Ceropegia (Tubered & Fascicle rooted) incl. C. mafekingensis
Brachystelmas (Tubered & Fascicle rooted) incl. B. natalense & B. schizoglossides
B. villosum
Brachystelmas (Tubered & Fascicled rooted)
B. macroptalum*
Tenaris
T. filifolia
M. burchellii
Sisyranthus
Key
+ Fascicle rooted plants
* Tuberous rooted plants

Figure 9

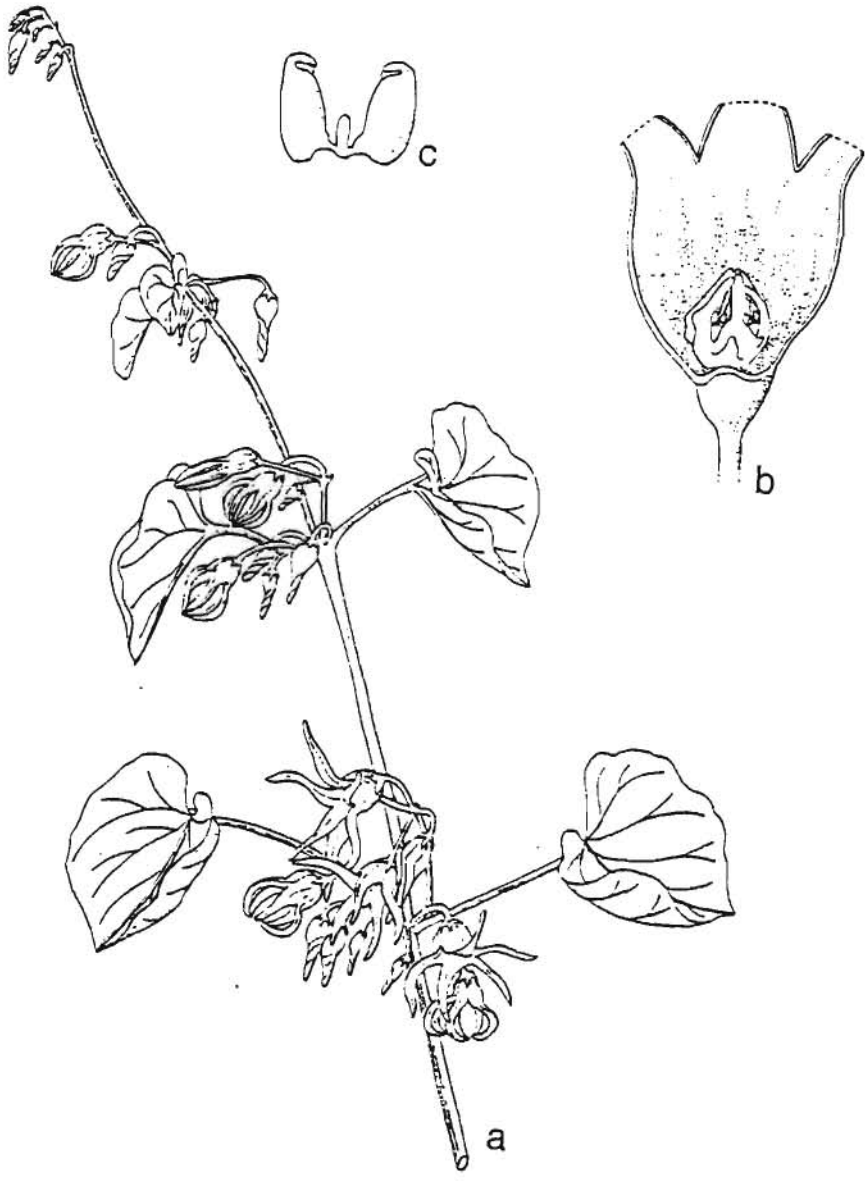

Figure 10

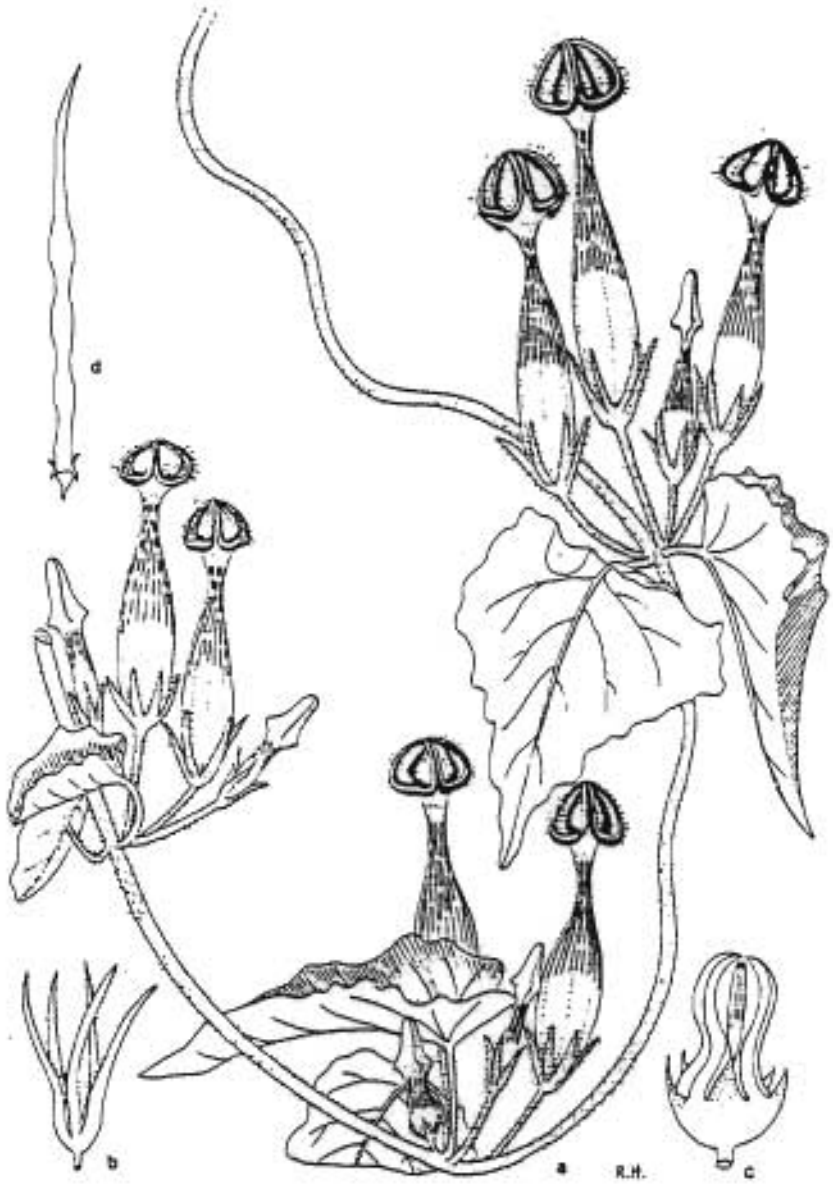

Figure 11

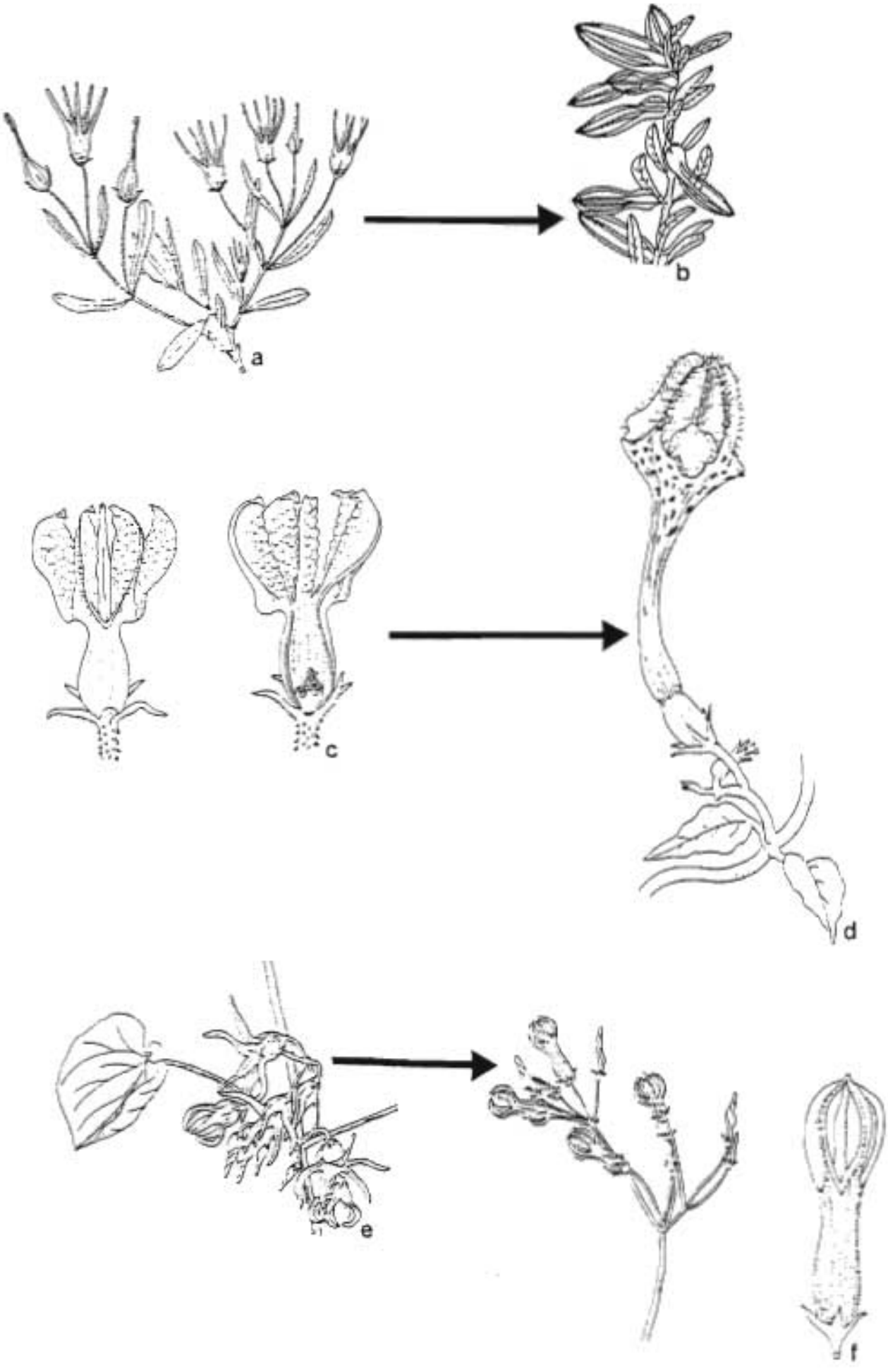

Figure 12